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THE PRACTICAL TEACHER

HERR F. FRITSCHI,
President of the Educational Conference at Berne.

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NOTES ON THE BRITISH ASSOCIATION MEETINGS, 1899.

BY OUR SPECIAL CORRESPONDENT.

THE meeting of the British Association, which was held in September at Dover, was not marked by the announcement of any very startling scientific discovery, though it presented features which were peculiarly its own. The leading characteristics of the meeting have already been discussed in our columns, and it only remains to call attention to the scientific matters which engaged the attention of the members at work in the various sections.

The number of foreign guests was perhaps larger than usual—a fact that may perhaps be attributed to the situation of the meeting-place. It was noteworthy that many of the Continental physiologists were present—a circumstance due probably to the reputation of the president. Among them were conspicuous Professor Kronecker of Berne and Professor Kossel of Marburg. Professor Calmette of the Pasteur Institute was expected, but he was unable to leave Oporto, where he was engaged on the Plague Commission. He sent a paper, however, which was read in one of the sections. Other distinguished visitors were Professor Ladenburg and Professor Fittig, prominent leaders in chemistry; Professors Campbell of California and Bourquelot of Paris, equally well known to botanists; Professors Hanriot, Cyon, Lemoine, Hjort, Julin, Rotch, Bauer, and Barker.

A good deal of very substantial work was done in the various sections. The addresses of the several sectional presidents were more than usually important, in many cases dealing with particular problems which had been the subject of their own personal study and research. Special discussions of various important questions also formed a very prominent feature of the sectional work.

SYMBIOTIC FERMENTATION.

One of the most interesting features of the proceedings in the chemical section was a discussion on the subject of symbiotic fermentation. The discussion was not carried on by the chemists alone, but invitations to take part in it were accepted by several members of the sections of physiology and botany, and several members of the French Association also were among the speakers. The discussion was opened by Professor Marshall Ward, the Professor of Botany at Cambridge, who gave a very clear and detailed account of what symbiosis is, and the various forms of it which exist in nature. The term is used at the present time to indicate a quasi-partnership between two separate individuals of different nature, who not only live together, but who work together for the common weal of the two, their association being marked by very close connection physically, and by a definite division of labour—the result of which is that both organisms are benefited by their alliance.

Professor Ward gave many illustrations of this and of kindred alliances, showing how many different degrees of advantageous association are met with, and how finally it might degenerate into the condition known as parasitism, in which the advantages of the alliance are all on the side of one of the organisms only. Turning to the more limited cases, in which such associations of beings are concerned in definite fermentations, he brought their work into line, with such biological features on the one hand, and with ordinary fermentative processes on the other. The chemical side of the problems of symbiotic fermentation was set out by Professor Armstrong,

Next Month:
OUR ILLUSTRATED SUPPLEMENT OF
THE NEWEST GIFT-BOOK LITERATURE.

who especially concerned himself with the special case of the way in which such conjoint organisms may be considered to attack the molecule of sugar. Professor Armstrong held that the only influence of the conjoint organism was that one of its constituents provided a suitable nidus for the growth of the other, or that perhaps they were mutually helpful in that way. Professor Reynolds Green combated this view, contending that the association between the constituents of the organisms was of a much closer character than this, and that there was a physiological influence excited by the one upon the other which went far beyond questions of mere nutrition. He supported his argument by a summary of the results obtained in fermenting sugar solutions by one of the so-called Kephir organisms, which are used in Asia in the manufacture of alcoholic beverages; showing that neither could work well in the absence of the other, and that the character of the products was largely influenced by the degree of association that could be induced between the two organisms. Professor Tanret, Professor Warrington, and Dr. G. H. Morris also took part in the discussion, which was, unfortunately, curtailed for want of time to complete it.

THE PHOTOSYNTHESIS OF CARBOHYDRATES BY PLANTS.

The presidential address of Dr. Horace Brown in the chemical section excited unusual interest. It was an open secret before the meeting that he would give an account of his own researches in a very important field of physiological chemistry—researches which have occupied him for several years, and which have led to important results, confirming and extending the views of the earlier observers, and clearing up many points which up to the present have been wrapped in obscurity. Nor did Dr. Brown disappoint expectation. After reviewing the history of this section of the problems of nutrition, he showed how he had put the various theories advanced to the test of actual experiment. Among the most striking results he obtained may be put the discovery that the power of an ordinary leaf in sunshine to absorb carbon dioxide from the air is more than half as great as that of a free surface of caustic potash. He further advanced evidence of a very cogent character to prove that the carbon dioxide enters the leaves through the stomata, and not, as Boussingault maintained, through the ordinary epidermal cells of the leaf. This evidence was based upon experiments upon the diffusion of carbon dioxide through small apertures, the conditions under which the rate of diffusion varies being especially studied. Dr. Brown found reason to believe that sugar and not starch represented the culminating point of carbohydrate synthesis. Finally, he described experiments and calculations bearing upon the actual utilisation of the radiant energy falling on the leaf, and showed that the greater part of the energy actually absorbed was applied to the evaporation of the water of the transpiration current, only one-half per cent. being made use of in the process of synthesis.

THE AGE OF THE EARTH.

The presidential address in the section of geology was delivered by Sir Archibald Geikie, who dealt with the fascinating but difficult problems of geological time. The great divergence of opinion that prevails on this subject between geologists, biologists, and physicists seems quite irreconcilable. Sir Archibald now holds that that portion of the history of the world which is registered in the stratified rocks of its crust probably extends over one hundred millions of years. But he said somewhat sardonically, "that if the palæontologists find such a period too narrow for their requirements, geology offered no decided obstacle to its being enlarged as far as they felt it needful for the evolution of organic existence on the globe." He combated the views of the physicists that all kinds of geological action must have been more vigorous and rapid during bygone ages than they are to-day, claiming that geologists have been unable to discover any indication that the rate of geological causation has ever, on the whole, greatly varied during the time which has elapsed since the deposition of the oldest stratified rocks.

ACTION OF LIGHT UPON METALLIC SILVER.

A very interesting communication was made by Colonel Waterhouse, the honorary secretary of the Royal Photographic Society, on this subject. He has found that when sunlight is allowed to fall upon a polished silver surface through a mask possessing some definite pattern, the metal is acted upon by the light, and a latent image of the mask is produced, which can be developed by exposing the illuminated surface to the vapour of mercury. Copper is sensitive in a somewhat similar way. The resulting photograph is full of detail, suggesting the old daguerreotype process.

THE VITALITY OF SEEDS UNDER EXPOSURE TO INTENSE COLD.

Some very remarkable investigations into this subject have been recently made by Sir William Thiselton-Dyer at Kew Gardens, with the collaboration of Professor Dewar. The results were communicated to the botanical section. Seeds of the vegetable marrow, mustard, barley, and pea were immersed in liquid hydrogen for more than six hours, the cooling being at first conducted gradually. This temperature is the lowest yet reached—being about 16° absolute, or more than 450° below the zero of Fahrenheit's scale After their stay at that point for the time stated they were removed, allowed to regain the normal temperature, and sown under the ordinary conditions. With not a single exception, they germinated normally. In another experiment no precautions were taken to secure gradual cooling, but the liquid hydrogen was allowed to drop upon the seeds as it was generated. This treatment was no more deleterious to the seeds than the former one. The results, which were most unexpected, open up a very large question as to the nature of life; for at such a temperature not even the simplest chemical reaction can take place.

A NEW METHOD OF RAILWAY SIGNALLING.

Among many interesting and important papers read in the section devoted to mechanical science, one of the most noteworthy was the contribution made by Mr. Wilfred Bouldt on the subject of railway signalling. He pointed out the defects which are palpable in all the systems at present in vogue, which may be said to depend on semaphores, lamps, or detonators; and discussed the failures that have been made to utilise light, sound, mechanical movement, and electric contacts. As a substitute for all these, he suggested the utilisation of magnetism without mechanical contact between travelling and stationary parts. Mr. Bouldt pointed out that this system had been made the subject of experiment by the Great Northern Railway Company, who had worked a trial apparatus on an express engine for more than two

BRITISH MUSEUM

months. The method had proved quite successful, for both home and distant signals had been given on each daily run, often when the engine was travelling at a speed of more than seventy miles an hour. Mr. Bouldt's anticipations are that his system will supersede the use of detonators in fog-signalling, even if it should not be found possible at present to establish magnetic signalling in regular railway working, though he hopes that such an application of it will soon be practicable.

WIRELESS TELEGRAPHY.

This was the special feature of the Dover meeting, the installations made during the summer between Dover, the South Foreland lighthouse, and Wimereux, near Boulogne, being freely used for demonstrations every day. In connection with this practical illustration of the method, a lecture was delivered by Professor Fleming, who has throughout been associated with Signor Marconi. The lecture was partly historical, tracing the progress of electrical knowledge from the early discoveries of Volta down to the present day. Especially interesting were his deductions as to the nature of electric and magnetic effects, which, he said, "though manifesting themselves in connection with natural substances, have their seats in actions taking place in an intangible medium, the ripples in which are waves of light, and the billows are the ether waves we are learning to employ." One of the illustrations of the lecture showed how explosives can be fired by means of electric waves without any communication by wires.

THE DISTRIBUTION OF RAINFALL.

The prolonged drought of this summer lent great interest to a paper read to the meteorologists by Mr. John Hopkinson, who had been studying the distribution of the rainfall in the south-eastern counties of England. He finds that, starting from Essex, more rain falls as one passes from east to west. Thus Middlesex and Hertfordshire show a greater amount than Essex, and Buckinghamshire exhibits more than either. Similarly, Sussex shows a greater rainfall than Kent. The distribution of the rainfall during the different months of the year shows some features of interest. All through the winter, Essex is the driest county; in May, Kent receives less rain than any other; as the summer advances, other counties in turn are driest. July finds least rain falling in Hampshire; August is driest in Surrey, and September in Oxfordshire. In February, and in all the latter portion of the year, Sussex is the wettest county; and in January and March more rain falls in Hampshire. In April, May, and June the wettest counties respectively are Berkshire, Buckinghamshire, and Oxfordshire.

ANTARCTIC EXPLORATION.

The projected expedition to the Antarctic region was the subject of much discussion in the geographical section; indeed, a very large portion of the time of the sessions was taken up in discussing the various problems which it will attempt to solve. Sir John Murray pointed out the general lines on which it is proposed to carry out exploration, and insisted on the importance of having two vessels simultaneously engaged—a large one, to navigate the circumpolar area, and to establish a number of stations that shall make simultaneous records; and a smaller one, to make meteorological observations. The desirability of international co-operation in the great enterprise was especially insisted upon by M. Henryk Arctowski.

APPLICATION OF STEAM-TURBINE MACHINERY TO CHANNEL STEAMERS.

The great success of the steam-turbine machinery as used in the new torpedo-boat destroyers has led to the idea of employing similar mechanism in the Channel steamers. It was hoped that a practical illustration of the new engines would have been possible during the meeting, but the hope was not realised. For fast passenger vessels the turbine system seems to offer great advantages. The weight is less, the consumption of steam is no more than in the ordinary system in vogue, and there is a marked diminution of vibration, while the possible speed is very considerable, ranging from 30 to 35 knots per hour. A model of a boat estimated to run at a speed of 30 knots was exhibited during the meeting. All the passengers will be under cover, and there will be ample promenade space. Luggage is to be contained in two large tanks in crates, which will be hoisted in and out by jetty-cranes at the termini; they will be adapted for placing in railway trucks suitably fixed for their reception. Another model, that of an Atlantic liner, was also exhibited. Such a vessel would be of nearly 17,000 tons, and having 38,000 indicated horse-power, would be capable of a speed of 26 knots an hour. It is interesting in this connection to remember that the new *Oceanic*, the largest vessel now afloat, is computed to cover only 22 knots per hour.

THE CASE FOR MANUAL TRAINING IN SCHOOLS.

BY J. GUNN, M.A., D.SC.,
Author of "Class Teaching and Management," etc.

PART I.

THERE are few subjects more prominently before the public mind at the present day than education. Its literature is spreading at an amazing rate, and in the most varied forms. Bluebooks, Acts of Parliament, "The Mighty Atom," and "Made in Germany" may be quoted as samples. In practical politics it leaves Home Rule a bad second. In all ranks and classes, from the Prime Minister to the youngest pupil teacher, men and women have set themselves to study its problems. Official bodies, ranging from Royal Commissions to rural School Boards, deal with the subject by way of investigation, legislation, or administration; while the wider field of speculation is occupied by unofficial and irresponsible bodies of every conceivable constitution. The number of adjectives which are attached to the term *education*, with more or less understanding, is significant, each of them forming a rallying cry in conflicts of the past, present, or future: compulsory, assisted, free; elementary, secondary, technical, commercial, classical; religious, physical, moral; with many more—their only common feature being that they are rarely used to mean what they seem to mean.

It was possible for Dr. Johnson in his day to affirm that all that would ever be found out about education had been found out long ago; and with the conception of education then current, his dictum was not without foundation. Since then men have begun to ask what the term really meant; and we may turn to Herbert Spencer for as good a definition as we have yet reached—that it is a preparation for complete living. We may accept the definition as satisfactory, and by means of it form a clear conception of what education really means, provided that we know, in the first place, what *complete living* includes, and, in the second place, what the *preparation* for it requires. To those who are in any doubt on these two points, the question of what education ought to embrace will still afford room for some discussion, how-

ever. And it appears that many people are by no means clear regarding this matter.

Whatever complete living may include, and granting to the full that bread alone does not afford the means thereto, our practical generation is becoming fully alive to the fact that bread at least is necessary; hence, doubtless, the fact that the "Made in Germany" view is at present attracting more attention than the "Mighty Atom" aspect of education. In other words, while the question of Church *versus* Board school has caused much noisy wrangling, it is the question of technical instruction that is regarded as of supreme national importance at the present time. The rise and growth of technical schools and colleges, and of higher-grade Board schools, and the introduction of manual training in elementary schools and evening continuation schools, show the beginnings of practical results from this trend of opinion.

The difficulty no doubt remains that if Education is a term of disputed signification, Technical Education must be still more so. *Solvitur ambulando:* we shall find out more clearly what both terms imply by watching the development of that practical training which the pressure of circumstances demands. Whatever "complete living" may imply for the individual or the nation, it implies at least something more than a "bare living." Our curriculum of school studies *may* provide for training the feelings and the taste; it *must* provide for training the hand and the eye.

It would seem that in our common school education, as in the evolution of dress, we have attended first to decoration, and afterwards—a long way afterwards—to practical utility. We have given much attention to the head—little to the hand; we have laid much stress on thinking—little on doing; we have put much value on capacity—little on faculty. But manual training is at last asserting its place. Educators are beginning to see that whatever education may include, *that* at least cannot be excluded. In view of this fact, we propose to examine the value of manual training as a factor in education, and to state briefly the case for including hand and eye training in any school curriculum. More than a mere summary of the position is, of course, impossible within the limits of a single article.

It may be well at the outset to attempt a general definition of our subject, both in order to secure clearness, and in order to avoid objections based on a wrong idea of the thing.

By manual training, or hand and eye training, then, we mean the use of certain exercises which have for their aim the training of the hand in accuracy and in dexterity of movement, always guided by the eye: the dexterity is not to consist in routine or merely mechanical movements, such as those of the feet in walking, or of the fingers in playing scales. Here is an important quality of the movements we mean: the training is not to enable the hand to act without thought-direction, but to fit the hand for carrying out what thought directs.

Another side of this training is the training of the eye to greater accuracy of observation. The observation that is involved in merely looking at things is very loose and inaccurate compared with the observation which results from handling things and making things.

The third aspect of this training is the resultant training of the mind. This, indeed, seems the most important side of the subject from the ordinary school standpoint. That training of the mind is of a type which can never be reached by mere passive observation, or by eye and ear training alone. The power of making a thing implies an entirely different mental picture of that thing from the mere ability to understand it. Thus manual training implies a special kind of intellectual training.

And, finally, there is an ethical or moral training involved throughout. The habits formed are neither those of inactive contemplation, nor of unintelligent manipulation.

Thus the mere mention of what we mean by hand and eye training hurries us beyond a view of it as something in a child's education which is a mere luxury and can be very well dispensed with. It begins at once to loom up large, and threatens to usurp a large portion of the whole field of education. In the fullest sense of the term, indeed, manual training includes a very great deal of what we usually mean by education; and what is more important still, it includes some things which we are apt to forget are essential to true education, and which our modern theories have too much neglected.

Now this remark might be seized on by an opponent, on the ground that he does not agree with our conception and definition of education. We shall not quarrel over terms, but rather try to see what at least education must include.

It is something artificial: the savage or natural man is not educated; he grows up. But growing up—the natural process—can be helped or hindered by circumstances; so that the grown-up individual may be a more or a less perfect specimen of the race. And that is pretty much all that education can ever mean—furthering the work of nature in this complete growing up. Whether all that passes for education is really helpful to this result, is a different question. Some of it we may see to be hurtful, if we look into it; and much that would help nature in making men and women of our boys and girls seems to be left out of our education programmes altogether.

The individual who is to grow up—the child—was only discovered about the beginning of this century. Of course the child existed many, many centuries before, just as America existed many centuries before Columbus. Columbus did not invent America; he only discovered that beyond those leagues of water there lay a continent undreamt of by the men he knew. So in the beginning of the present century the child was discovered, not invented; and the navigator who crossed the superstition and convention of past ages to make the discovery was Froebel. That which Froebel discovered we are only now beginning really to explore.

Froebel's discovery led to the obvious conclusion that the child himself must be the chief factor in this education or growing-up process. It was clear to him that children grew up *as a whole*, and that there must therefore be unity in all our educative efforts—a fact not yet quite clear to us perhaps, who would educate the child in water-tight compartments, so to speak, part mathematical, part linguistic, and so on. It was also clear to Froebel that the child grew up and developed *through his own activity*, and that whatever is truly educative must be done by the child himself, not by his teachers—another fact to remember by those who dream of educating a few score specimens of the child all at once, as the spinning-frame draws out a hundred threads of cotton all exactly alike.

Through his discovery of the child, Froebel was led to the invention of the kindergarten, name and thing alike. The name we are all familiar with. The thing, how many of us really know? But Froebel's development of his new discovery and his new invention was sadly hampered, and even arrested, by political movements—for when did political considerations do aught but hinder education? And so Froebel's kindergarten never expanded beyond what we might call the nursery stage. So we have continued to regard kindergartening as something which stops at the age of seven or eight, something to take up the child's time pleasantly until his *education* can begin in earnest.

There could not be a greater blunder. Froebel's leading thought was the unity of the child; and to divide his education by a cross section at the age of eight, or at any other age, is to go right in the teeth of all Froebel tried to teach us.

The true followers of Froebel, then, are not those who devote their efforts to the spread of kindergarten principles as he *left* them—the mere foundation or truncated base of the pyramid. His true followers are those who seek to go beyond this, and to devise a complete educational course on his principles—developing the child as a unity, through his own self-activity, through *doing* and not through looking and listening and believing, and remembering—and forgetting. We do not mean that Froebel neglected the importance of what we vaguely call observation and instruction by the ear; but he saw, as no one had seen before, and as few have seen since, that apart from activity these things are weak and worthless in aiding the growing up of the child to full manhood.

The natural activity of the child, as Froebel discovered him, is play. So the first thing we can do to aid his development is to help him to play. This idea comes even yet

as something revolutionary and unsettling to most views of education—we are so apt to think of play as the opposite of education; and truly we often do our best to make them opposites. Froebel's *gifts*, as they are called, are simply so many interesting playthings—the soft ball, the coloured balls, the hard sphere, the complete cube, and the divided cubes. It was through games played by means of these playthings, and through songs to accompany them, that he designed to exercise the observation and the imagination of the child—not through lectures on form and colour where the objects are used as mere illustrations of the lesson.

After the *gifts* came the *occupations*, so called. These were designed to give scope for purposeful activity of hand and eye in constructing and imitating the forms of things. On Froebel's principles of unity and continuity in education, the occupations are closely connected with the gifts; but as the use of the gifts may be regarded as a means of *taking in* knowledge, so the occupations rather form the means of *expressing* that knowledge, by constructing of the given material the forms already known. The occupations in common use, as all teachers know, are paper-folding in regular forms, plaiting of coloured slips of paper in various patterns, stick-laying, constructing various outline forms by means of pointed sticks or wires inserted into softened peas, mat-weaving, and the like; while solid forms are imitated in plastic clay, and by means of paper and cardboard fastened with glue.

It is hardly necessary to point out how much of more formal education may be tacked on to such exercises. Instruction in number and measurement, information regarding the objects being copied—such as fruits, leaves, animals, and the like—and many other examples, will readily occur to you.

Beyond this point Froebel's labours were not systematically continued, and hence, as we have said, the use of hand and eye in education has hardly emerged beyond the nursery or infant-school stage. But the nature of the child does not change suddenly at that or at any other age. It broadens and deepens, but the stream runs on without a break. Hence, if we believe that Froebel's use of the child's activity was based on sound principles, the problem for us is, how to continue his education on the same lines.

From the early age at which Froebel dealt with the child, his attention was naturally turned more to the effect of these occupations on the child's intellectual development than to their value as developing manual dexterity. But when we attempt to extend such a system throughout school life, it naturally assumes more or less the form of what is known as manual training. Manual training is therefore the natural and logical outcome of kindergarten work. The problem of the future, indeed the problem of the present, very largely is this question of manual training in schools. What is its value—intellectual, moral, and industrial or utilitarian? And what are the methods by which it can be best secured? Is it merely one of the scores of *fads* which obscure the question of education? or is it an essential thing in the growing up of men and women, who are, after all, not merely disembodied spirits, and who have twice as many hands as they have heads?

In discussing such points, it may be well to make clear that manual training, the training of hand and eye, is *not* certain other things which are sometimes confused with it. For example, it is not to be confused with *physical* training. Physical training is carried on in schools (or should be) by means of various forms of gymnastics, of drill, and of calisthenics. The object of this physical training may be said to be the development of muscle, strength, and grace. The object of manual training, again, is to develop the power of performing accurate and purposeful movements, for which strength is by no means the most important requirement. Again, manual training in its higher phase is sometimes confused with *technical* training. But the object of technical training is to teach how to produce perfect and complete objects of a certain kind; the object of manual training is to produce a perfect or complete man or woman—one whose fingers are not all thumbs, as we say, but whose hands are perfectly under the control of the brain, and whose movements, guided by the trained eye, are responsive to the demands of the intellect. The aim of hand and eye training, again, is *not* to teach a handicraft, and thus form an aid to money-making; though, if this result did follow, it would be no great objection to the principle involved, nor would the presence of this aim argue a low conception of education.

It is a strange fact, and one worth looking into, that the utilitarian aim in education is regarded as debasing only when we are dealing with the education of the artisan. When the education of the professional man is in question—the doctor, the lawyer, the politician, the journalist, the minister, the teacher—we approve of such studies as will be of direct value to him in his profession, and we assume that these subjects properly studied will bring sufficient mental culture. And I believe we do so rightly. But when the artisan is in question—a class which will necessarily be always in an overwhelming majority—we start back at the idea of moulding *his* school education with a direct view to his future career. Now I do not insist on the value of manual training as a training specially valuable for artisans. I base its claims on the wider ground that we shall find it to be the best aid to intellectual and even moral training for all. But I protest against its being undervalued simply from the idea that it has a utilitarian look about it. I believe that the neglect of hand training is due to the ignoring of—if not to the ignorance of—the laws of brain activity and the best means of developing the brain.

This leads naturally to one of the points I wish to notice regarding manual training—its relation to the brain. We are accustomed to speak of the brain as the organ of thought; and we know that the best thinking can only be done with a well-developed brain, in good health, well nourished, and not fatigued. This much we may be all agreed on.

But I wish for a moment to take a different view—perhaps eccentric, but one which the study of this subject has forced upon my mind. While the brain is the organ of thought, thinking is by no means the primary function of the brain. Assuming that thought may loosely be described as a product of the brain, I should rather describe it as a *by-product* of brain action, though it may be the most valuable product. There are certain manufacturing industries which were started with the view of producing a certain thing, but which actually make more profit out of some *by-product*, regarded at first as mere waste material. The work proper of the brain is twofold—receiving stimulus through the senses, and causing muscular movements in the organism in response to such stimulus. All through the animal world the brain acts thus, in animals where we do not usually consider thought to be one of its functions. Feeling, and consequent movement—these are the primary functions of brain and nerve.

To examine the brain of an animal will give no clue whatever to the degree of intelligence of that animal; but it will give an exact clue to the complexity of that animal's organisation, sensory and motor or muscular. Hence the similarity of the brain of the higher apes to that of man. This similarity does not argue similarity in intellect, but it corresponds exactly to the similarity in sensory and muscular development. And if we trace the growing complexity of brain upwards through the hierarchy of animal life, we find an evolution of brain in exact correspondence to complexity of muscular and sense apparatus in the animal; but only by accident, as we may say, does it correspond to the animal's intelligence.

That which causes—or, to be safe, that which accompanies brain development, therefore, is not intelligence, but complex powers of movement. So if we wish to imagine further development of the brain in man, the factor of chief importance would seem to be, not to cultivate the power of abstract thinking, but of exact and varied movement. In short, the superior complexity of the human brain is but the counterpart of the superior mobility and delicacy of the human hand, that part of our body which raises us farthest above the other animals. In brain and hand alike, man is fit monarch of nature.

Now let us return once more to orthodox lines. If the superior brain is necessary to the superior thinking power, as it probably is, and if the superior brain is a necessary

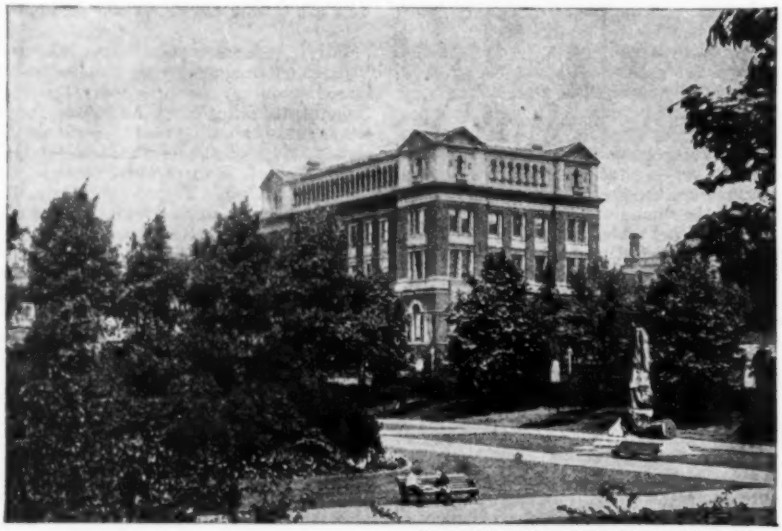
accompaniment of the skilful and obedient hand, then the connection between a trained hand and a trained mind is no mere chance connection, but is rooted in our physical, and therefore in our mental, nature.

Here then, I think, we have one important fact to keep in mind as bearing on the intellectual value of manual training: the well-developed brain is necessary for high mental power; but the brain has not been, and therefore we may conclude it cannot be, developed merely by the exercise of thought—it must also be developed by the exercise of muscle. The value of sense-perception in the development of brain I do not now insist upon, for the simple reason that it is already recognised in our educational theory, if not in our daily practice. Yet the sense of *touch* and the *muscular sense*, with sense of weight and resistance, *cannot* be developed apart from manual work.

(*To be continued.*)

THE ROYAL COLLEGE OF SCIENCE.

AT the bottom, every national institution owes its existence to the genius and dogged perseverance of some enlightened citizen, endowed, to use the words of Edward Gibbon, with "a heart to resolve, a head to contrive, and a hand to execute." To this rule the college, whose important function it is to make the pace for English science, is no exception, and Sir Henry de la Beche is the man to whose credit the initiation of this national college must be put. The beginning was a somewhat curious one. It was in 1832 Sir Henry sought and obtained permission to adorn the maps of the Ordnance Survey with certain gaudy colours, which, to the initiated, indicate the nature of the rocks lying below the surfaces thus adorned. To-day these geological maps are so very common that it is difficult to believe that we have ever been without them, even so far back as the beginning of the Queen's reign. The geological map begat the geological survey, and out of the survey grew the Museum of Economic Geology, which in turn evolved the "School of Mines and of Science applied to the Arts," which was opened on November 6, 1851, at the Museum of Economic Geology in Jermyn Street. The aim of the school thus inaugurated was a special one—to wit, the training of mining engineers; but, partly on account of the apathy of the special class for which the school was intended, but mainly by reason of the crying need for better all-round instruction in science, especially as applying to the various industries, the scope of the college was slowly but surely enlarged, until in our time it has become a veritable scientific university, embracing within its purview the whole of the industrial sciences. In 1853, when Professor Hofmann, who has set his seal for all time on the science of chemistry, was appointed to the professorship of this subject, the name of the institution was changed, its new title being the "Metropolitan School of Science applied to Mining and the Arts;" and ten years later it was again thought good to baptise the growing offspring of Sir Henry de la Beche's fertile brain, the name chosen on this occasion being the "Royal School of Mines." To complete this history of the nomenclature of the college, it is only necessary to add that in 1890 the students of the Normal College of Science—for the school soon developed into a training institution after the Science and Art Department had taken in hand the provision of instruction in science for the benefit of the industrial classes—agitated for a better baptism of their side of the school, out of which agitation grew the name of the Royal College of Science; howbeit the mining side of the institution still holds to the more ancient title of the Royal School of Mines. It will not be necessary for us with "tedious homily of words" to recite the various moves and counter-moves that led to the removal of all the sections of the college from Jermyn Street to the Exhibition Road. The following extract from a speech of Professor Huxley, the great advocate of the practical teaching of science, cannot, however, fail to interest. It is distinctly good to think of the great teacher as an "involuntary impostor," as he describes himself. "I cannot say that they [certain extremely grave defects in the constitution of the college] arose from the fault of any one concerned, but from the fact that the necessities of scientific training were understood a quarter of a century ago in a totally different way from that in which they are now understood. The only provision that was made for that practical instruction which is the heart and soul of all efficient scientific instruction, in the original School of Mines, consisted in the laboratories for chemistry and for metallurgy. For no other branch of science was there any efficient practical instruction provided; and even the accommodation for chemistry and metallurgy was so imperfect that, within a few years after the foundation of the school, laboratories for these purposes had to be sought elsewhere. For eighteen years I did my duty towards the institution as well as I could, lecturing about natural history, and, I am sorry to say, with the more or less definite consciousness that I was an involuntary impostor, and that



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THE ROYAL COLLEGE OF SCIENCE, AND ROYAL SCHOOL OF MINES, SOUTH KENSINGTON.

it was not possible for me to teach in any genuine fashion, because I had no room in which practical instruction could be given. I do not know whether my colleagues would be inclined to make the same confession, but the same want must have been felt in teaching physics, and in the other kinds of instruction given at the school. Moreover, we had no mathematical instruction, and in spite of our repeated representations, it was not provided.

"Now that state of things obtained up to the year 1872. By that time some of us had got extremely tired of it—and I was one of those who were so tired; my chemical colleague was another; my colleague the Professor of Physics was a third; and we got up a sort of a little pronunciamento to say that we really could not go on teaching in that way any longer—that at South Kensington there was a large building which was standing perfectly empty, and might we be allowed to do our business in a more efficient way by being transferred to this empty building? With the assent and consent of our colleagues, and with the sanction of the Department of Science and Art, the desired transference took place, and the result of that was that all the professors, who were moved, were able at once to institute a more or less adequate system of practical instruction, and to make the teaching in the school in their own departments something like what it ought to be. Subsequently the Professors of Geology and Metallurgy and Applied Sciences were similarly moved; and now only the Professor of Mining remains at Jermyn Street, simply because he has there the admirable collection of models which are so important for his work."

It remains to add, by way of completing the tale of the journey of the professors from Jermyn Street to South Kensington, that in 1890, upon the death of Professor Smyth, the mining models were removed, and that the lectures have since been delivered in the Metallurgical Lecture Theatre at South Kensington—thus putting an end to the irritating journeys and counter-journeys of the students between the two centres.

And now that the tale of this Hegira has been told, another approaches, for overcrowding is again the condition of affairs at the Royal College of Science and the Royal School of Mines; and if the National Scholars, the Royal Exhibitioners, the Local Exhibitioners, the Free Students, the Science Students, and the Private Students—for so the classes of Royal Collegians are variously designated—are to be adequately housed, another exodus must result, as the following quotation from the old Students' Register, to which we would here express our obligation, will show—and, indeed, a partial exodus is not only contemplated but is already arranged for:—"There are already twice as many applications for admittance as there are vacancies. Mining and Elementary Physics have been driven from the main building into temporary sheds on the other side of the main road, while Geology has only been able to find, at a distance of over half a mile from headquarters, suitable rooms, for which a considerable rent has to be paid. Every year it is becoming more urgent that the authorities should bestir themselves to provide a new building suitable to the requirements of the National College of Science and the chief School of Mines in this country. One of the chief reasons urged for the removal of the school from Jermyn Street was the want of accommodation, but never has that want been more severely felt than at the present time.

"The '1851 Exhibition Commissioners' have done their part, offering the site opposite to the Imperial Institute, valued at £100,000, for the new science museum and school, if the Government will provide the building fund."

It is to be regretted that the Government will *not* provide the building fund, except for accommodation for the chemical and physical sections of the college. Indeed, one of the chief objections to the scheme recently decided upon for the completion of the Victoria and Albert Museum, as the erstwhile South Kensington Museum is now called, is that the claims of the Royal College of Science have met with but scanty recognition—a fact greatly to be deplored when one reflects how much the efficiency must of necessity depend upon the accommodation.

On the occasion of our visit to the college in the interests of THE PRACTICAL TEACHER, we had for *cicerone* Mr. Frank Castle, one of the demonstrators in the mechanics' laboratory. To this gentleman, so well known to our readers as a regular contributor to our Science Section, we beg to convey our most hearty thanks for his kindness in sparing so much of his valuable leisure time to show us into every nook and cranny of the South Kensington warren; for such, indeed, the building with its intricacies appeared to be.

Arrived at the square building in the Exhibition Road, we were conducted *viâ* a hydraulic lift to Mr. Castle's laboratory. We could well understand, in this building of staircases and stairs, how very necessary this self-same lift must be. Certainly the architect did not show much regard for the economy of space in designing the building, which comprises four floors, with rooms ranging round a square gaping space which should have been utilised in the provision of more classrooms, instead of standing there mocking the cry of the professors for more room. We found Mr. Castle ready to receive and also to inform us; and if our respect for the building decreased with increased acquaintance, this was not the case with respect to the apparatus, which everywhere was of the most useful and ingenious description. Moreover, the South Kensington professors have learned by experience how to successfully deal with comparatively large classes of students, as will appear from what follows respecting the mechanics' laboratory, but which is equally applicable to the other laboratories of the institute. Fixed to the walls, and arranged on tables throughout the laboratory, are the many pieces of apparatus to be used by the students. To each piece of apparatus is affixed a number, and there is a sheet of directions, distinguished by a corresponding number, whereby the students are categorically informed as to what experiments they are expected to perform with the apparatus in question. The students work in twos, and upon entering the room they find a paper whereon are to be seen the groups of names, with the number of the apparatus upon which they are to work. It remains for the students to go to the demonstrators, who supply them with the numbered directions, upon obtaining which they are able at once to proceed to work. The more expensive and portable apparatus is kept under lock and key, and each student can only obtain these pieces of apparatus by giving a receipt therefor, which holds him responsible for the apparatus until such time as he redeems his receipt by returning the apparatus. We give a copy of the paper of directions supplied to students who are working on pieces of apparatus numbered 1 and 2.

ROYAL COLLEGE OF SCIENCE, LONDON.

MECHANICAL DEPARTMENT.

(1) and (2).

THE TRIANGLE OR POLYGON OF FORCES.

Attach a sheet of drawing paper to the blackboard by means of drawing pins. Put weights into all the scale-pans, and wait until the ring which is attached to the cords bearing the scale-pans has taken up a position of equilibrium. Then carefully mark the line of each cord on your drawing paper, as well as the amount of pull in each cord, being careful to put on each line an arrow-head representing the sense of the force. Having detached your drawing paper from the blackboard, lay it on the table, and plot a polygon with sides parallel to the lines found as above, and of such lengths as shall represent the amounts of the forces to scale, the arrow-heads representing the senses of the forces running round circuitally. See if your polygon is a closed figure, noting the error if not, and repeating the experiment until three or four tolerably accurate figures have been obtained.

You will find that with given loads there is a region within which, anywhere, the centre of the ring may be placed without disturbing the state of equilibrium; find the shape of this region in any case.

(To be continued.)

THE EXCELLENT PHOTOGRAPH of Mr. J. H. Devonshire addressing the gathering at Sydenham, of which a small reproduction appears on page 240, can be obtained from Mr. H. Hallier, Artistic Photographer, 41 High Street, Upper Sydenham, at the following rates:—Mounted on a platemark marginal mount, 3s. 6d. each; unmounted on a roller, 2s. 6d. each.

A PRACTICAL TEACHER AT THE HOLIDAY COURSES.

I. GENEVA.

"Il m'entretint de ses voyages, et le sachant Anglais, je crus qu'il m'allait parler d'édifices et de peintures. Bientôt je vis avec plaisir que les tableaux et les monuments ne lui avait pas fait négliger *l'étude des mœurs et des hommes.*"

ROUSSEAU, *La Nouvelle Héloïse.*

THE orthodox English tourist, especially on his first visit to Switzerland, is filled with a holy zeal "to do the thing properly" and thoroughly. Accordingly you find that a huge alpenstock shadows him wherever he goes. In his haste to reach the mountains, he would fain have a railway direct to Chamonix; Geneva is almost beneath his notice; he does the Glacier des Bossons, the Mer de Glace, the Brévent, the Flégère, perhaps even Mont Blanc, in quick succession, and then rushes off to get his alpenstock marked with the signs of his mountaineering triumphs. He has a rigid programme of "climbs" and excursions which must be executed at any cost, and he has no time to waste upon *l'étude des mœurs et des hommes.*

On arriving at Geneva, then, I felt drawn in two directions. Should I be a tourist rushing round to "do" a maximum of the great sights of this Grande Exposition de Beautés Naturelles which we call Switzerland, or should I be true to my motto, "*Homo sum; humani nihil a me alienum puto*"? I decided upon the latter course; I would see at least a glimpse of the cosmopolitan student life of Geneva.

After spending only three days in the town, then, I found myself at the university, armed with my letter of introduction and other credentials, which obtained for me at once a most courteous reception from M. Bernard Bouvier, "administrateur du séminaire de français moderne, et directeur des cours de vacances." For the benefit of the uninitiated, I ought to explain that this "seminary" is a subdivision of the faculty of literature and social science of the university, and is intended for foreign students who can make a prolonged stay, while the holiday courses are meant for students whose time is limited. Monsieur Bouvier was busy receiving the names of newly-arrived students—Swedes, Italians, Czechs, Germans; in fact, people from every corner of Europe and America. He at once gave me permission to attend any lecture or conversation group whatever, and even took the trouble to point out the interesting items which still remained upon the programme for the day, so that I might lose no time. English students who intend to visit these courses next year may rely upon receiving from Monsieur Bouvier unfailing courtesy and kindness. At 5 p.m., then, I take my place in the great hall of the Conservatoire de Musique, amid a company of loquacious students of divers tongues and of every conceivable type of countenance. The lecturer is M. Edouard Rod, and his subject one which naturally fills the mind of the stranger who visits Geneva—Jean Jacques Rousseau. I have strolled down the Rue Rousseau; rested under the shady trees of the Ile Rousseau. I have seen the beautiful spots immortalised by the *Nouvelle Héloïse*—Vevey, where dwelt Julie, the sweet amorous *pécheuse;* Meillerie, where St. Preux dreamed and despaired; Clarens, where my wanton eyes sought for the "bosquet" and the "chalet." What need to say that the lecture is for me an intellectual feast! And the fact that M. Edouard Rod is no mere critic, but a *romancier célèbre*, does not detract from the interest. He gives a brilliant sketch of Rousseau's peculiar genius—extravagant, inconsistent, paradoxical, powerful; "his impossible ideal of woman as *amante* and *amie;* his strange passion-tossed life (*sa vie trop accidentée*); his real greatness as shown by the tremendous magnetic effect of his books upon the people of his time; lastly, the weakening of morals, and the rise of the revolutionary spirit, caused by his works." With my mind well prepared for the subject, I found the lecture a treat from beginning to end, and was not surprised at the enthusiastic applause given by the delighted *auditeurs et auditrices.* Then followed the singing-class (*Section de chant*), conducted by M. Ferrari, professor of music at the Conservatoire. The main object of this class was naturally the pronunciation of the French; but apart from this practical utility, it seemed to me an admirable arrangement for promoting good-humour and social intercourse among the students. I shall not soon forget this chorus of all the nations, chanting the praises of little Switzerland,—

"Glaciers des monts, troupeaux joyeux,
Coteaux féconds et gracieux,
Vallons, forêts, sommets neigeux,
Terre toujours nouvelle."

Those students of French who are musically inclined cannot do better than procure the book used—*Chants populaires de la Suisse romane*, Librairie Georg et Cie, Corraterie 10, Genève. At 8.30 p.m. I introduced myself for the first time to one of the conversation groups, for which an additional fee of six francs is paid. The groups are arranged here as evening walking parties, each being under the guidance of a master from the Collége. This is a plan much to be preferred to the ordinary conversation class, for in the open air that bugbear constraint soon vanishes, and the talk becomes free and natural. Monsieur Gardy welcomed me politely, and then introduced me to his international followers—several Germans, an Austrian, a Czech, and an Italian. I found it admirable practice to converse with people of so many different nations, and my opinion of French as a medium of international intercourse rose very high. Then, too, it is so easy to learn by mutual correction. For example, I had an argument with an Italian upon the subject of such words as *cinq, cent, pincer, penser*, which argument we finally settled by an appeal to the professor. I hope the Italian was grateful to me for improving his accent. So we strolled on through the Champel quarter until we came to the precipitous banks of the Arve, and could hear the roar of the "Gletschermilch" far below. Then we turned back towards the town—as M. Gardy jocularly phrased it, "C'est le bout du monde, il faut retourner." Subsequently, the professor, Mons. Thévenaz, took us all, ladies included, with another group, to the *terrasse* of a *brasserie*. There we sat, a merry group, drinking the mild, harmless *bière blonde*, comparing notes as to our respective fatherlands, laughing at the witty sallies of the professor, with the Rhone far below scintillating in the myriad lights of the town. I think this happy, genial, jovial, yet intellectual life would do English students no end of good.

9 a.m.—The next day I attended M. Bernard Bouvier's class—*Exposés et discussions.* A Russian lady mounts the platform, and in very good French relates a story, which M. Bouvier afterwards criticises as being merely an exact repetition of the piece. He seems to require the student to be something more than a phonograph. Then other students make attempts which are not so successful, and criticisms follow each attempt. It will be seen from this that the Geneva courses are not for beginners, but for teachers who can already speak and understand French fairly well.

10 a.m.—*Stylistique* (*allemand*), Monsieur Ch. Bally. Here we have translation and the study of the synonym taken at the proper stage—namely, with advanced students, not, as in England, with mere beginners. Each student has a collection of extracts from modern German writers, which are to be translated into French, with careful study of synonyms and alternative expressions—for example, *l'armée approche, l'hiver approche* (*mouvement graduel*); *je m'approche de la table: tout de suite, aussitôt, sur le champ.* As the lecturer says, his aim is to enable the student to manipulate all the varied expressions of the language (*la gamme des mots*), as a pianist can touch the whole range of keys. There is a similar class for translation of *English* passages into French. Another admirable course was that conducted by Monsieur Henri Mercier—*Psychologie et pédagogie appliquées*—in which addresses upon all kinds of scholastic subjects were delivered *by the students* and afterwards criticised. I have only space to enumerate one or two subjects—namely, "Les récompenses scolaires," and "Quelle méthode doit suivre le professeur pour enseigner une langue étrangère vivante à une classe de débutants?" These are subjects upon which a teacher is bound to wax eloquent, if his powers of speaking French

allow of eloquence at all. One very suggestive remark was made upon the new method of language teaching—namely, that it was *more difficult for the teacher*. What a picture that calls up of a teacher who cannot speak French instructing unhappy juveniles in the mysteries of French grammar, French exercises, French without pronunciation! And will that old, fatally easy, fatally dull method ever cease among us as long as our language examinations remain as they are? Can we not get admirable diplomas without being able to speak French? And cannot our classes "obtain excellent results" without learning to speak French? The lecture on school rewards was splendidly delivered by a student, and M. Mercier in his criticism gave us a most humorous description of a French distribution of prizes—its foolish love of pomp and display, the heart-broken sorrow of the unsuccessful ones, the various types of presidents, the presidential addresses, etc.

Littérature classique (M. Bernard Bouvier).—The subject of the lecture which I had the good fortune to hear was the Tragedy of Racine, with special reference to his *Britannicus*. The professor gave a splendid exposition of the work of Racine, and his conception of tragedy, showing that *Britannicus* was not a mere dramatic picture of Roman times, but rather a portrayal of human passion interesting for all time—the struggle between good and evil in Nero's mind, between the young Nero of the past and the Nero that was to be, the monster of crime and passion. The personification of Good and Evil by Burrhus and Narcisse was also finely traced: and the lecturer showed how Racine neglects all opportunities for spectacular display, choosing only certain events which lend themselves to the portrayal of human passion. Monsieur Bernard Bouvier added to the charm of his able lecture by his fine declamation of illustrative passages; and both his courses of lectures—*littérature classique et littérature contemporaine*—strike one as being thoroughly prepared and admirably delivered. I regret that space will not allow me to discuss his lecture on Victor Hugo.

Diction (Monsieur Thudichum).—Now I come to a subject which, though not so thrilling in interest as Racine, Rousseau, or Victor Hugo, is nevertheless of paramount importance to the foreign student of French. I find the genial, persevering Monsieur Thudichum seated at a table in the Aula (great hall), with students in front, and one student, whose reading is to be tested, beside him. As the reading goes on, Monsieur Thudichum makes rapid notes. Then follow corrections, criticisms, exercises, valuable hints—for example, *pi, pu, pi, pu; ki, ku, ki, ku; c'est une minute utile; c'est une inutilité*, etc. The phonetic exercises were extremely minute, and would surprise English teachers who hardly know the difference between *é* and *è* (*stupéfait* = *stu-pé-fè*).

Saturday excursion.—It is a pity that space will not permit me to give a full description of our excursion to the château of Voltaire at Ferney, and the *réunion amicale* at the great international school presided over by Monsieur Thudichum. The 150 students met at a station in Geneva, embarked in a steam tram, packed like herrings in a barrel. Each *étudiant* escorted an *étudiante;* and everything seemed to provoke mirth, for we were all in such high spirits after our week's work. At Ferney we saw the mausoleum containing the heart of the great *poète-philosophe*, and copied in our notebooks his last verses. Then away to Professor Thudichum's, where the strains of a good band bade us a musical welcome, and where our hosts shouted forth to us all a most genial exhortation, "*Faites comme si vous étiez chez vous.*" Then host and hostess, band and students, started on a marvellous walk—half dance, half march—over the grounds, the long, happy procession passing and repassing, up and down, until we reached the belvedere upon the summit of the building, whence we had the most wonderful view of the Juras, the blue shimmering lake, the Alps of Savoy. Then followed dances, speeches, refreshments, and the evening passed as if by magic (*dem Glücklichen schlägt keine Stunde*).

Monsieur Thudichum was so kind as to give me at parting a special invitation to visit him and his great international school, a description of which would perhaps interest the readers of THE PRACTICAL TEACHER.

The next day, with the resolve to recommend these splendidly organised courses to all English students sufficiently advanced; with my brain simmering with thoughts of Racine, Rousseau, Voltaire, and Victor Hugo; with new notions of the infinite variety and vastness of human life; with recollections of new types of beauty and intellect, new charms of accent, intonation, and gesture; with my mind braced by friendly intercourse with fellow-teachers hailing from Baku in the East to Spain in the West, from snowy Sweden to sunny Italy; with pleasant memories of walks and talks by the swift-flowing, sparkling Rhone; with my voice humming Swiss melodies, and my heart thrilled with the first glimpse of the *sommets neigeux*, I sail up the blue Lake Léman towards the ancient city of Lausanne.

THE EDUCATIONAL CONFERENCE AT BERNE.

INTERVIEW WITH THE PRESIDENT, HERR F. FRITSCHI.

BY A SPECIAL CORRESPONDENT.

THOSE who are familiar with the conferences of English teachers will know that it is by no means easy to make good a claim to even a half-hour of the limited leisure at the disposal of the president. As leader of a great assembly, he has not only the business to guide, but also many a social function to fulfil. The president of the Swiss Teachers' Association has all this, and something more: he is the very heart of the Association—president, editor of its journal, speaker, worker. It is difficult to realise what the Association would be without Herr Fritschi.

I was anxious, therefore, to obtain from his own lips a brief statement of his life's work; but anything like a quiet, formal interview proved impossible, so many were the claims of the Congress, and so frequent and hearty were the greetings of old friends. But at last, during the course of one of the many friendly gatherings, I managed to get him into a corner, and in the intervals which the programme allowed I gleaned the following:—

"I was born in a small village near Winterthur, and at the age of sixteen entered a training college near Zurich, with a view to becoming a teacher. Of course I had received the ordinary education of a Swiss lad in the primary school. Every one *must* have that. I was in the college for four years, and during that time we used to go into the model school three times a year, to receive instruction in practical work.

"Having obtained my diploma as primary school teacher, I served for three years in a country school, taking the upper classes.

"My next move was into a school in the suburbs of Zurich, and there I continued my studies in history and languages, going through the university course.

"But, you know, you cannot properly learn foreign languages by staying at home, so I spent two years abroad—in England, France, and Italy. While in your country I had the pleasure of visiting many schools along with Dr. Fitch—he is 'Sir' now, is he not? Well, he knew much about the schools, and was always very kind to me. Then, too, I knew Mr. Dugard, one of the inspectors, and I have very friendly recollections of him.

"We used to go to schools together, and I watched your methods and your work. You have many good things in your English schools, and some bad. Yes; it is not good to have children teaching other children. They cannot do it properly. We do not have that in Switzerland—only, of course, in the model school of the training college, and then the teachers are being taught.

"When I was in Florence I used to write for our paper, the *Lehrerzeitung*, and it was very lucky for me that I did; for once when all my money had run out, and the supply I had expected had not come, and I was wondering what I should do, there arrived a small payment for some articles I had sent to the paper, and that just helped me through."

"Then you had no scholarship, or anything of that nature, to help you through?"

"Oh, no! We go on our savings. Sometimes the substitute who has taken your place in school is younger than the teacher away, and then there is the difference between the salary due to the teacher away and that paid to the substitute. But it is not much, and you must depend on yourself.

"I passed my examination as a teacher in a secondary school, and having obtained an appointment, I spent some years teaching boys between the ages of twelve and fifteen.

"After my experience at Florence, I took care to keep up my connection with the Press, and I used to send articles on education in England and Italy. Hence, when Dr. Wettzein died, I was appointed editor of the *Lehrerzeitung*, and have kept that office ever since.

"Yes; I am now master of a secondary school at Zurich. It is a large school of boys and girls between the ages of twelve and fifteen.

"In addition to school work, I have had the chance of filling some offices in my town.

"You know that in our large towns we have an authority known as the *Grosser Stadtrat*. This is not the executive for governing the town; but when the executive make any new proposals concerning the control of the people, or expenditure, or such like, they must submit the proposals for the sanction of the *Grosser Stadtrat*. I am a member of this larger body.

"Then, too, there is a legally-organised body called the *Schul Synode*, consisting of all the teachers—primary, secondary, and university—in Zurich. They have made me the president, and our secretary is a professor of the university.

"The *Schul Synode* has the right to nominate two members to serve on the Council of Education for the Canton of Zurich. One must be a master or professor of higher schools, and this office is now filled by the principal of the training college. The other representative must be a teacher in primary or secondary schools. I have the honour of being that other representative.

"You know that in Switzerland every canton manages its own educational affairs. Some do it well, and some not so well. But Zurich is one of the best. We have now many excellent primary and secondary schools, all with adult teachers. The Bund does nothing for the primary schools. You know we were talking about that in the Minster this morning, and we want the Bund to do for us what the State now does for your schools in England, so that all the cost may not fall on the locality. But up to the present all our primary school work and the greater part of our secondary and technical work is done by the council of the canton, on which body the teachers have the right to be represented.

"When the town of Zurich was extended by the inclusion of populous suburbs, I was head of the teaching body, and as such was representative on the School Commission from 1893 to 1896, and took part in building up the educational system which now exists.

"I am also editor of the *Pädagogische Zeitschrift*, though of that we publish only six numbers a year. For ten years I have seen every sheet of the *Zeitung* before going to press, so that I have not had much time for holidays; but every year I go into the mountains for a short rest.

"I am also an examiner for training colleges, and a member of the commission for examining recruits for our army."

"And now, Herr Fritschi, how did you become president of the Teachers' Association?"

"I had been a member for some years, and I found that they were in the habit of electing the council in a very poor way. The delegates said, 'They have done their work very well this year—let them sit another year;' and so all were re-elected. The members who were not delegates had nothing to say in this, and we had no new members of the council. I wrote against this many times in the *Zeitung*, and argued that every one should have a vote; and at last the system of *scrutin de liste* was adopted, and at the first election I was placed at the head of the poll, and thus became president. That was five years ago, and I have been president ever since. When I became editor there were 1,000 teachers in our Association. There were 2,000 when I was first president, and now there are 4,800."

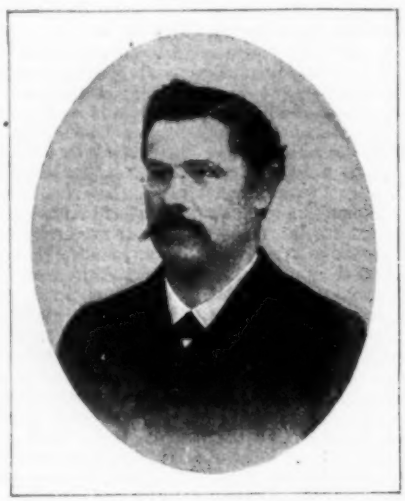
"Do you like teaching?"

"Oh, yes; it's my life's work."

Then came a shout of, "Fritschi, we have been looking for you; you are wanted," and he was carried away by some members of his committee, to make a speech elsewhere.

Such is a rough sketch of the man who has done much for his profession, and served his country well as teacher of children and leader of men.

Herr Fritschi is about forty-five years of age, and though lines of grey are showing themselves in his thick, dark hair, yet he stands erect, broad-shouldered, firm, with clear, open face; a man you could readily accept as a guide, and gladly welcome as a friend. In the pulpit of the Cathedral Church he stood with hands resting on the ledge on either side, his black coat tightly buttoned over his broad chest, and there, fearless, enthusiastic, he delivered his presidential address, and in rugged phrases which went direct to the hearts of his people, he urged them to greater labour for their schools, their union, and their fatherland.



HERR F. FRITSCHI.
(President of the Swiss Teachers' Association.)

HERR DR. FISCHER.

Another well-known Swiss teacher is Dr. Fischer, of the Secondary School for Girls in Berne, and Secretary of the Organisation Committee of the Swiss Association.

"Tell me, Dr. Fischer, something about yourself."

"I have not much to tell," came the reply, in almost perfect English, "but you are welcome to the little.

"I was born at Guttannen."

"Oh, yes; that is near the Handegg Falls, is it not? I wanted to stay there once some years ago, but did not like the look of the hotels, and had to walk on to Imhof."

"But there will be a good, a very good hotel there soon. I have bought the ground and the wood, and will build an hotel."

"What! the learned doctor will become hotel-keeper?"

"No; but I will have a good hotel there. Yes, I too was a student in the training college, and obtained my diploma as a primary school teacher; and after teaching for a few years I went to the west of Switzerland, near France, to learn the French language more perfectly. German I studied in Munich, and English in University College, Gower Street. I know London well, and particularly the library at the British Museum. I saved £100, and then went to England for two terms at University College. It cost me all my savings and a little more; for money goes so fast in England! But I knew, if I could only manage it, there would be a good appointment for me when I came home. I took my degree as Doctor of Philosophy, and am now teacher in the Higher Girls' School at Berne, where we have the exhibition to-day. There are fifty-three teachers there, and I take a class of about thirty girls between the ages of fourteen and eighteen."

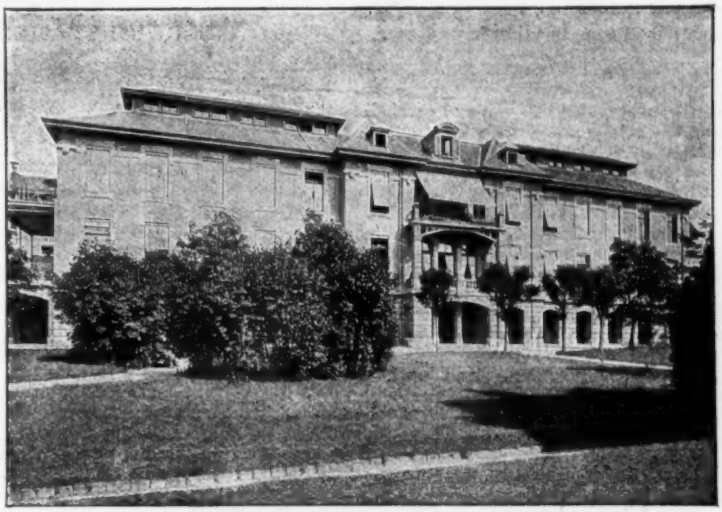
"Where do the girls go afterwards?"

"Oh, into the post and telegraph offices, and other government departments; others go into commerce and help their parents, some day to have shops themselves."

Dr. Fischer had taught for three years at Thun, and during a visit to the exhibition there, it was pleasing to note

the friendly recognition of the teacher shown by many of the young women at the various stalls.

"You see," said the doctor, "they are still fond of me. But in Berne there is great freedom between the teacher and his pupils. We hold that the teacher must know every pupil, her wants and inclinations. Without that you cannot do good work, and hence there is much confidence between pupils and teachers. So we keep the classes small and the teachers many, and we find it pays well in the end. The parents, too, have more confidence in it."



THE PAVILION AT THE BERNE UNIVERSITY.

Dr. Fischer is younger and of a quicker temperament than his friend and colleague, Herr Fritschi; but he has been, and is still, an ardent student and worker. In French, German, and English he expresses himself with ease. His knowledge of educational methods at home and abroad is surprising, and his devotion to the cause of Swiss education, and to the Association of which he is a secretary, is hardly surpassed by that of his friend and colleague, the president.

THE CONFERENCE MEETINGS.

BY A SWISS CORRESPONDENT.

Do you know Berne at all? Of course you do. Capital of Switzerland; fifty thousand inhabitants; quaint old place on the river Aar, with a fine Gothic cathedral, and a good set of handsome modern buildings, etc., etc.

When I arrived there, on Sunday the 8th of October, in the afternoon, I went first to the large hall of the Gymnasium (Classical School), where the delegates of the Swiss Teachers' Union were to assemble. I was surprised to find the president, Herr Fritschi, delivering an address in English, and thought I had got across the Channel by mistake. I soon found out he was welcoming Mr. Ernest Gray, M.A., M.P., one of the secretaries of the National Union of English Teachers. After the following words of welcome there was great cheering, and I felt delighted at having once again heard the Queen's English.

THE ANATOMICAL SCHOOL AT THE BERNE UNIVERSITY.

HERR FRITSCHI'S WELCOME TO MR. ERNEST GRAY, M.A., M.P.

"I heartily welcome Mr. Ernest Gray, one of the secretaries of the National Union of Teachers, a member of Parliament of growing influence, and one of the foremost champions in the English teachers' great struggle against payment by results, and for free classification and fair judgment of school work.

"Your presence here, Mr. Gray, is a great honour to our Association, and I hope this meeting will be the beginning of a beneficial intercourse between the teaching bodies of England and Switzerland. You are one link more, Mr. Gray, in the strong chain which unites England with Switzerland—that chain of illustrious Englishmen who honour us with their stay in our country, and also with the splendid books for which they find inspiration in Switzerland. Let me only mention among them Professor Freeman, the historian; Professor Coolidge, the great scholar, historian, and mountaineer; Professor Tyndall, who has written such fine books upon the subject of Swiss glaciers; and not to forget Alfred Austin, your present poet-laureate, who is fond of Switzerland, and the scene of whose finest book is in our own country.

"Many of your countrymen of high authority in matters of education—such as Matthew Arnold, Sir Joshua Fitch, Mr. Acland—have taken much interest in our educational system. We are proud of it; but I am sure we can learn much more in England than you will ever learn in Switzerland. During the last few years you have made great improvements in education, on which we heartily congratulate you; and I hope that a great many Swiss teachers will have opportunity of studying the progress made in your schools, and enjoy a stay in a country where I, long since, passed one of my happiest years.

"I shall be pleased if your visit gives you pleasure. May I beg you to convey the heartiest greetings of the Swiss teachers, especially of Schweizerische Lehrerverein, to the National Union of English Teachers.

"Be heartily welcome, sir, in our midst."

THE PENAL CODE.

Mr. Zürcher, Professor of Law at the University of Zurich, then gave his address on some articles of the Swiss penal code (in preparation only, for till now every canton had a penal law of its own!) referring to juvenile criminals. In future, children under fourteen years of age cannot be brought before a judge. When they have done wrong, they

are given over to the school authorities, who are to punish them, and, what is far more important, to provide for them in a way that will improve their character. Legal provisions of this kind already exist in the Canton of Basle, and they work very well. There is no need to say that Professor Zürcher's propositions were unanimously adopted.

SCHOOL BOOKS AND "HEIMATKUNDE."

Several motions were then brought forward, and carried, dealing with the question of abandoning the old system of every canton having its own school books, and creating instead, with the help of cantonal and federal subsidies, a series of Swiss standard books for primary and secondary education. Among the first to be published will be an atlas for primary and secondary schools, and another for classical and technological schools, training colleges, etc. Next will be prepared a school book for Science and Natural History for secondary schools, and a collection of Object-Lesson Wall Sheets for primary schools. Steps also will be taken to encourage and help teachers in the working out of "Heimatkunden." I hardly think there is an English word covering the meaning of "Heimatkunde." "Heimat" means home—the village, town, valley, district where we spend the early years of our lives; "kunde" means knowledge. Heimatkunde is the forerunner of History, Geography, and Natural History in the elementary classes, and comprises that part of the three subjects which refers to the village, town, or valley where the children live. It is evident, then, there cannot be a standard book for Heimatkunde, as the subject differs from place to place. The teacher has to create everything himself. He must draw a map of the village and its environs about three miles round; he must construct a relief corresponding with the map; he must get up a mineral, botanical, and zoological collection, and write a small book about the history, the climate, the produce, and traffic, etc., of the place—everything on a limited scale, of course, and well within the grasp of a child's mind.

MANUAL TRAINING.

On Monday morning the primary teachers held a separate meeting at the French church, to discuss the best method of combining Pestalozzi's principle of observation with Froebel's principle of Manual Training. A resolution was passed in favour of introducing Manual Training as a compulsory subject into all our primary schools, two hours a week to be given to the new branch of learning, at the expense of those other subjects likely to benefit most by the introduction of Manual Training—namely, Euclid, Arithmetic, Geography, Natural History, and Drawing. It is to be regretted that a special meeting of the teachers of the Swiss training colleges on the day following did not arrive at similar conclusions. The cantonal training colleges, it was said, differed in every respect so much from one another that, much as the introduction of Manual Training was to be desired, the matter must for the present be left to cantonal management.

MODERN LANGUAGE TEACHING.

While the primary teachers were discussing Pestalozzi and Froebel, the teachers of the Swiss "Mittelschulen" (which term applies to all schools between the primary schools and the universities) heard an elaborate lecture on the latest methods of instruction in modern languages, by Professor Caminada of Aarau. Any modern language, he said, could be learned best by imitation. The teaching must in the beginning be exclusively oral, and at this early period object lessons are of great service. Later on these may be abandoned in favour of reading and conversation on incidents of school life, on important events of the day, and on the personal experiences of the pupils. Grammar is not to be taught as a separate subject; it, however, fills the important part of a steward whose services cannot be dispensed with. Special attention must be paid to dictation, and the pupils' mother-tongue must be used as little as possible and dropped entirely—the sooner the better. As the new method has rendered the work of the teacher much harder than before, the local authorities and the Government ought now and again to give him leave of absence and grants which would enable him to spend a few months in the foreign country whose language he is teaching.

THE SWISS TEACHERS' UNION.

At eleven o'clock a general *meeting of the Association* took place in the cathedral. We heard, first, a beautiful piece on the great organ; then the choir of the town teachers gave Mozart's *Weihe des Gesanges*, with the accompaniment of a numerous orchestra. After an address of hearty welcome delivered by Herr Stücki of Berne, the president, Herr Fritschi, gave a short sketch of the history of the Association. The idea of a National Union of Swiss Teachers dates from the days of Pestalozzi and Stapfer, at the beginning of this century. A first attempt to form an association was made about 1825; but it was not until 1849, at the small town of Lenzburg, near Aarau, that two hundred and thirty-five teachers decided to establish the "Schweizerische Lehrerverein." Half a century has passed since, and much work for the improvement of teaching methods and appliances has during this time been done by the Association all over the German-speaking part of Switzerland. The Association now counts nearly five thousand members. It publishes two papers—the *Schweizerische Pädagogische Zeitschrift*, a quarterly review, and the *Schweizerische Lehrerzeitung*,* a weekly paper—besides periodical reports on new literature suitable for children's and village libraries. The *Lehrerkalender*, a notebook for Swiss teachers, published yearly in revised editions, has also proved a success. The Association has created the "Erholungs" and "Wanderstationen," which means it has secured special terms with a considerable number of hotels all over the country for teachers wanting a holiday, or convalescents needing a few weeks of quiet rest. During the last few years it has also established a fund in aid of Swiss teachers' widows and orphans. The fund at present amounts to 50,000 francs, and will only be touched when the amount is doubled. I may mention here, that the Swiss teachers, a short time ago, also received a legacy of 1,000,000 francs in landed property for the establishment of a retired teachers' home. The efforts of the association next will have to go towards not only getting our members into the local and cantonal boards of education, but also to sending a few into parliament, as our colleagues in Bavaria and in England have already succeeded in doing.

Then followed the chief subject of interest of the three days' gathering: "Die Bundessubvention der Volksschule," that is—

GOVERNMENT GRANTS FOR PRIMARY SCHOOLS.

Hitherto the confederation has paid subscriptions to technological and commercial schools only, the cantons and the communes having to provide for primary education. The consequence is, that in some of the poorer cantons, where the population is sparse, the number of schools is inadequate, the payment of the teachers very poor indeed, and the results the same. Three orators spoke on the subject—Herr Gass, Councillor of Education, Basel; Herr Locher, Chairman of the Board of Education, Zurich; and Herr Ritschard, Councillor of State, Berne. When they had finished their speeches, fourteen hundred teachers rose to their feet as one man to pass a resolution, that the association should without delay undertake every legal step towards an early and satisfactory solution by the federal authorities of this all-important question.

Again we had the choir and the orchestra, and the music from the organ of the old cathedral, while the crowd streamed out through the portals into the sunny streets.

In the evening, lectures were delivered by several professors of the University:—

Dr. Graf: "The New Wall-Map of Switzerland, and how it is made."

[* *We are greatly indebted to the Editor and to the proprietors of these journals for their kindness in allowing us the use of illustrations which appear in connection with this contribution.*—Ed.]

Lambelet: "Swiss School Statistics."
Dr. Zeller: "A Trip through the Libyan Desert."
Dr. Koenig: "Electric Apparatus for Schools."
Dr. Schenkel: "Röntgen Photography (X-Rays)."

In the forenoon, Herr Hartmann, an engineer from Frankfort-on-Maine, lectured on the construction of appliances for the teaching of natural science, producing a series of instruments for the measuring of electricity. About the same time, a special meeting of the Swiss Union of Abstaining Teachers was held. Herr Hercod from Montreux read a paper on, "Le rôle de l'école et du maître dans la lutte contre l'alcoolisme à l'heure actuelle." Herr W. Weiss from Zurich read one on the same subject in German. The conclusions arrived at were that the time has not yet come when the setting forth of the ruinous influence of alcoholic drinks could be introduced as a special subject into the programme of our Swiss schools; but much might now be done by the way, and, as in everything else, the best thing would be the good example of the teacher.

CORRIDOR ON THE GROUND-FLOOR OF THE MONBIJOU HIGHER SCHOOL FOR GIRLS, BERNE.

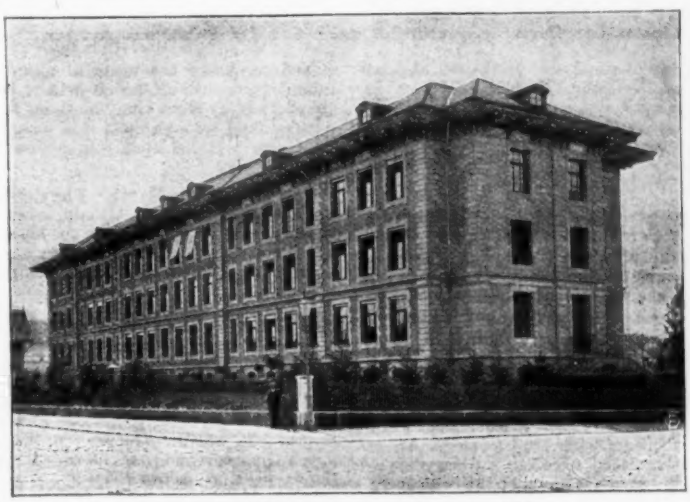
On Tuesday morning there were five special meetings of different sections.

The *Lady Teachers* discussed at length the founding of complementary schools (Fortbildungsschulen) for girls, in which not only needlework but also German, arithmetic, house-keeping, and hygiene are to be taught. Some towns and large villages already have such schools. The lady teachers will unite their efforts that the good example be followed universally throughout the country—the expenses for such schools to be paid by the communes, the cantons, and the Confederation.

The *Technological School-Teachers* (Lehrer an gewerblichen Fortbildungsschulen) endeavoured to draw the exact line between primary education and general complementary education on one side and technological education on the other. I have now to say a few words about the *teachers of special classes for*

THE FEEBLE-MINDED.

In this section Herr Fisler of Zurich read a paper on the organisation, the programme, and the teaching-staff of such classes. Herr Fisler is the authority on the subject; a man who puts not only his whole intellect into the matter, but, like Pestalozzi, his whole heart too. He said the classes for the feeble-minded must form an inherent part of our system of primary schools. No pupil ought to be put into such a class before having passed a twelvemonth at least in an ordinary class, and then only on the strength of a pedagogical and medical examination. On no account should there be more than twenty-five pupils in a class, and the children ought to be under the same teacher as long as they attend school. The necessity of putting a child back into a normal class very rarely shows itself. Public examinations would do no end of harm with the feeble-minded; but towards the close of the year the parents ought to be told that they are welcome to come and see their children at work any time they please. The teacher should draw up a conduct list, or, if I may use a book-keeping term, open an account for each pupil, and credit it with the deficiencies in the character of his parents, the shortcomings of his social surroundings, and also with any little talent or sign of good character he may show. Such a record may furnish useful hints for choosing the boy's calling later on. With regard to the number and position of working hours, the site and outfit of the schoolroom, sufficiency of food, outdoor games, gymnastics, manual training, and gardening, these classes should occupy the special attention of the school authorities. A teacher for the feeble-minded must have had several years' teaching-practice with normal children in a school where he had to manage several classes in the same room, as he will also have to divide his class of from twenty to twenty-five feeble-minded children into several groups according to their defects in speech or hearing. He must, moreover, have a sufficient knowledge of patho-psychology, anatomy of the brain, physiology of language, anomalies of speech, eyesight, hearing, etc., and know something of the methods of teaching the deaf and dumb. And last, not least, he must love his work; for it requires untiring perseverance and unceasing patience. There cannot, of course, be the question of payment by results in his case; he ought to get fewer hours and better pay than his colleagues with the normal classes, and the authorities must give him a chance to return to ordinary school work as soon as his strength is in danger of giving way under the heavy burden he has taken upon him.



THE KIRCHENFELD PRIMARY SCHOOL AT BERNE.

The *section of teachers of the German language* heard a lecture by Professor O. von Gregerz on the Swiss dialects as a basis for the teaching of High German.

At ten o'clock the second general meeting took place at the

French church, where Director Balsigen of Berne and Rector Niggli of Zofingen read papers on the ways and means by which the Federal Government could aid primary and secondary education. For, let it be said, the matter is not by any means as easy as it looks, seeing there are cantons that will tell the Government, "We do not want your money; we want to be left alone. As soon as we accept Government grants, we shall have Government inspectors too, prying into our educational affairs." And, as a rule, these are the very cantons whose schools would profit most by federal aid.

THE GYMNASIUM SCHOOL AT BERNE.

THE PERMANENT EXHIBITION OF SCHOOL-BOOKS, ETC.

On Tuesday afternoon I went to look at the "Schulausstellung" in the new schoolhouse of Monbijou. The building is quite a palace, with all the latest sanitary and pedagogical improvements. A prominent feature of the exhibition was its international character, and its promoters deserve great credit for their earnest attempts to get the best things in the teaching line from everywhere.

The United States Bureau of Education had sent in a series of very interesting diagrams on a large scale, showing the extent and nature of educational work done in that country. Of English origin there were, for instance, a Royal Wall Atlas, Royal Wall Portfolio Series, and the Royal French and German Object Lesson Wall Sheets, published by Thomas Nelson and Sons of London, Edinburgh, and New York. The best wall sheets for Bible teaching are those of Lohmeier; also the "Masterpieces of Christian Art," published by T. T. Weber, Leipzig, will prove of great service. Several cantons exhibited carefully-graduated collections of needle-work, dressmaking, and products of manual training made by the pupils. Mr. Lambelet, secretary of the Federal Bureau of Statistics, had drawn up a number of very large diagrams showing the proportion of expenses for war and for education in the European states; the percentage of private schools and public schools (primary, secondary, and complementary) in Switzerland; the comparative expenditure for schools of the confederacy, the cantons, and the communes; the general progress of education in Switzerland from 1887–1896; a very instructive table of the teachers' pay in all the cantons, with Basel at the top and the Valais closing the train, etc. These diagrams excited general interest. It is so much easier to get at the facts with their help than when you have to hunt up a whole volume of figure columns. As special features of the exhibition I may further mention—A series of wall sheets on first aid to the injured; stomachs of herb-eating animals, prepared with oil of clove and filled with air, for natural history lessons—after use the air is pressed out and the stomach-skin put up again; an assorted collection of apparatus and appliances for the teaching of science; a series of object lesson wall sheets for the feeble-minded; MS. by Herr James Heller of Winterthur, which will be published shortly; and as I am writing for English readers, I must not forget to mention a collection of appliances for gymnastics and outdoor games. Cricket, I am sorry to say, was not represented, but the noble game of football was—a game which is daily gaining ground in our Swiss schools. Not all the teachers like it, of course. Some find it too rough; but the boys don't. I know a case where a master hid the ball to have done with this barbarous sport once for all. But as the youngsters began kicking about a boy's hat, he thought it wiser to hand it up again. So they won, and they will go on winning.

Elements.—In an address to the American Association for the Advancement of Science, Professor Venables discussed the nature of the chemical elements. Referring to the conclusions to which investigations lead, he claimed that the hypothesis that the elements are built up of two or more common constituents has a larger number of supporters, and would seem more plausible, than Graham's hypothesis. Some have supposed one such primal element by the condensation or polymerisation of which the others were formed. Others have adopted the supposition of two elements.

There are many practical difficulties in the way of these suppositions: the lack of uniformity in the differences between the atomic weights, the sudden change of electro-chemical character, and the impossibility, so far, of discovering any law underlying the gradation in the properties of the elements with the increase of atomic weights, are some of the difficulties. It is possible to think of valency as dependent upon the character of the motion of the atom, but one cannot well conceive of a similar dependence of atomic weight and all the other properties. There remains, then, the hypothesis of primal elements, by the combination of which our elements have been formed. These molecules are probably distinguished from the ordinary molecules by the actual contact and absolute union of the component atoms without the intervention of ether.

Since these elemental molecules cannot as yet be divided, the name atom may be retained for them; but the idea of simplicity and homogeneity no longer belongs to them. The definition of an element as a body made up of similar atoms, is equally lacking in fidelity to latest thought and belief; but chemists would scarcely consent to change it, and, indeed, it may well be retained, provided the modified meaning is given to the word atom. But, after all, an element is best defined by its properties. It is by close study of these that its chemical nature is decided, and through them it is tested. Complete reliance can no longer be placed upon the balance and the supposed atomic weight.

The Age of the Earth: Physicists versus Geologists.—Sir Archibald Geikie, in his address to the Geological Section of the British Association, chose for his subject the vexed question of the age of the earth. The speculations of Lord Kelvin based upon (1) tidal action, (2) secular changes, (3) the age of the sun, give an estimate of from four hundred millions to ten millions of years as the possible limits to the age of our planet, with an increasing inclination towards the acceptance of the lower rather than the higher estimate. Professor Geikie says that these physical speculations are no further reliable than that they indicate that the geologist must set some bounds to his imagination in respect to the age of the earth. At the same time, he claims that quantitative geology and palæontology, if carefully carried out, are more competent to settle the question than physical speculation; and he called upon geologists throughout the world to commence the work of accurate measurement. It is impossible to deny the force of this contention, and it is to be hoped that there will be an immediate response to Sir Archibald's appeal for the inauguration of quantitative geological work.

ALL knowledge which is not followed by action is unprofitable and imperfect, like a beginning without an end, or a foundation without a superstructure.—*Cicero.*

Our Monthly Retrospect

EDUCATION IN ENGLAND.

N.U.T. NOTES, ETC.

BY T. B. ELLERY, F.R.G.S.,

President of the National Union of Teachers, 1895-96.

Bristol's Record Dinner. At the Tenth Annual Dinner of the Bristol Teachers, in aid of the Benevolent and Orphan Funds, on 6th October, 107 teachers and guests were present, with the popular Lord Mayor (Herbert Ashman, Esq.) in the chair, supported by leading members of the School Board and City Council, managers of Voluntary schools, and representatives of other public bodies. This dinner is rightly considered by our Bristol friends as one of their most important annual city functions. The collection amounted to over £120—a record amount. Mr. J. H. Yoxall, M.P., was in excellent form in responding to the toast of "The Imperial Parliament," and the speeches generally were crisp, short, and witty.

Among the teacher speakers were Mr. Harry Coward (N.U.T. Executive), Mr. F. G. Williams (president, Bristol Association), Mr. W. T. Crank (local "Charities" secretary), Mr. W. L. Dowding (Dinner secretary), Mr. J. T. Francombe, and Mr. R. Dugdale, J.P. Congratulations are due to the Bristol teachers, especially to those who have worked so hard and so successfully in the good cause. Who will follow this excellent lead? My friend and colleague, Mr. Coward, who has been so closely connected with this Bristol effort, will gladly give the fullest information to any association desirous of holding an annual dinner.

Promotion for Mr. T. F. Bowers, B.A. Reference was made last month to the London County Council appointment secured by Mr. Shadrach Hicks. It is a pleasant duty now to congratulate another member of the Executive, in the person of Mr. T. F. Bowers, B.A., upon his appointment to the head-mastership of the Technical and Commercial School, Woolwich Polytechnic. Mr. Bowers was a pupil teacher in the Tabernacle Schools, Elephant and Castle, S.E., was trained at Borough Road in the years 1877-78, and has taken the London B.A. degree. The whole of his teaching career has been spent in connection with the London School Board. He was an assistant-master, first at Hornsey Road, Holloway, and afterwards in the South Lambeth Road Higher-Grade School. His first "headship" was at Addington Street, Lambeth, S.E., from which he passed not long ago to the "John Ruskin" School, Camberwell Gate, S.E. He has met with great success in almost every department of school life; he is a well-known writer of school books; and he has found time to render valuable service both to the Metropolitan Board Teachers' Association and to the N.U.T. He now takes charge of a "mixed" school which is in receipt of grants from the Woolwich Local Board and the Technical Education Board of the London County Council. The governors are, it is said, desirous of conducting the school in such a way as to meet the growing requirements of Woolwich for boys and girls whose parents wish their children to continue their education on commercial and technical lines. There are three departments—(1) preparatory; (2) commercial; (3) technical. While in the preparatory school, the children will receive a sound education on secondary lines, including work specially directed to fit them for the senior departments. On the commercial side the course will include French and German, and a thorough training for business pursuits. On the technical side there will be courses in mathematics and science. And as there are 15,000 artisans employed in the various shops in the Royal Arsenal, one can readily imagine that such a school ought to be, and in capable hands will be, a very great success. The governors are to be congratulated upon having secured such an able man as Mr. Bowers for the post of head-master. Those who know him best are confident he will give a good account of himself in his new sphere of labour.

The Passmore Edwards House for the Orphans of Teachers. At last our hopes have been realised, and "Our Boys" have found a Home which is at once a credit to the profession, and a standing tribute to the zeal, industry, and enthusiasm of those who have laboured long and earnestly to bring about the desired result. It would be manifestly impossible in these notes to mention all the workers. Two, however, stand out prominently—namely, Mrs. Burgwin and Mr. Richard Greenwood—and to these the thanks of the teachers of the country are due. It was Mr. Greenwood who first interested Mr. Passmore Edwards in the effort to secure a better home than the one at Peckham Rye. Now the veteran has the satisfaction of knowing that his labours have been crowned with complete success. Mrs. Burgwin, too, as Chairman of the Sites Committee, has spent hundreds of hours in endeavouring to find a suitable home on a suitable site. She has had the assistance of a hard-working band of ladies and gentlemen, who have for a long time past sacrificed their leisure and spent both time and money in the good cause.

Backed by the London teachers, whose "special effort"

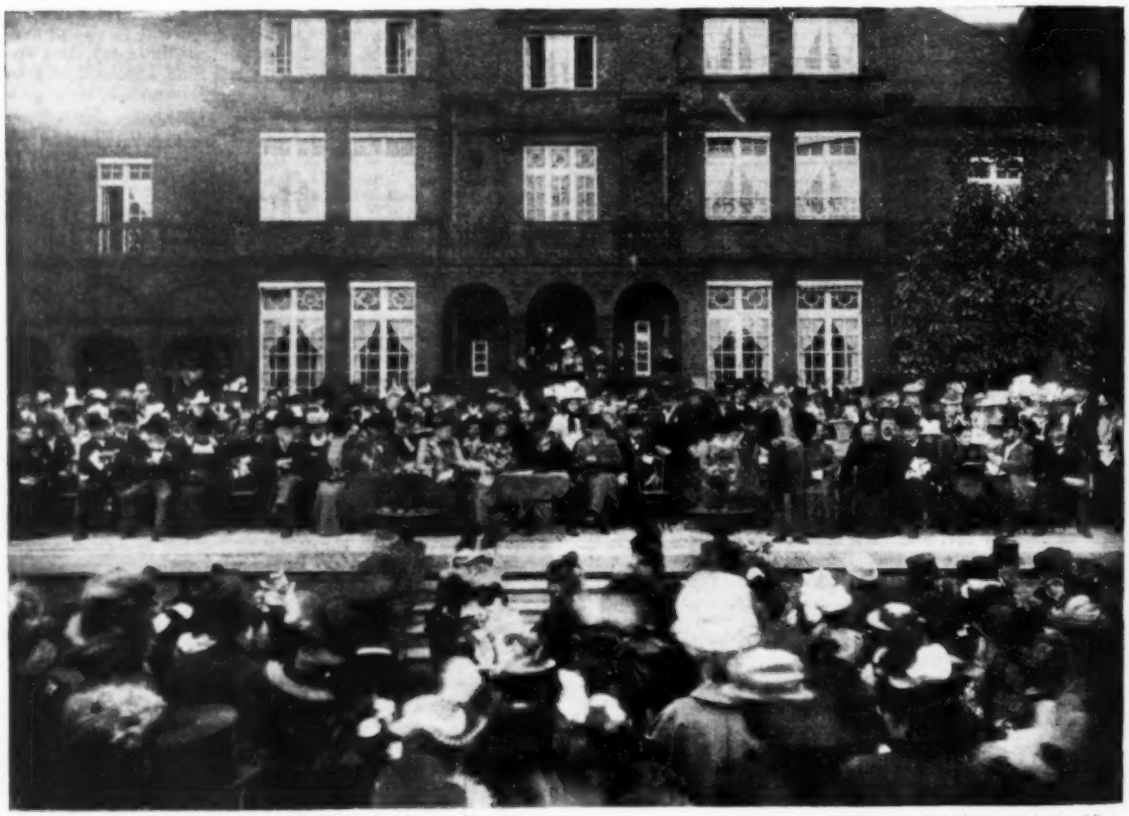
Photo by T. B. Ellery.

A FEW OF THE MANY AT SYDENHAM.

deserves the highest praise, the leaders of the movement have gone forward, confident that the large amount necessary, in addition to the generous donation of Mr. Passmore Edwards, would be forthcoming. The new Home is to-day an accomplished fact, and with the apostle of old we can thank God, and take courage.

The Cost of the Place. We are indebted in the first place to Mr. Passmore Edwards, who gave £6,000; and in the second place to the generous vendor of the house and grounds at West Hill, Upper Sydenham, Mr. C. J. W. Ribbits, J.P.,

who agreed to accept £10,000 when he knew that the orphans of teachers were to find a home there. The exact value of the property I do not know, but it is certain that £10,000 is a ridiculously low figure. There are five acres of land, a mansion "fit for a prince," approached by a charming avenue one hundred yards long, gardens, paddocks, and lawns. One heard, indeed, that the fireplace alone in the magnificent music-room cost £1,000! That the teachers of the country have secured a bargain, therefore, must be patent to all who give the matter a moment's consideration. Here sixty boys can be accommodated without a suspicion of crowding. The great anxiety now is as to the annual cost of keeping the Passmore Edwards House in its present state of beauty and comfort. Apart from the question of food and clothing, etc., this item of buildings (wear and tear) must always be a serious consideration. But after all, I have faith in the teachers who have laboured so nobly in the past, and there is no doubt we shall now appeal successfully even to those who have never yet felt much interest in the charitable side of the Union's work. At any rate, if this Home and its possibilities for good do not touch their hearts and their pockets, nothing ever will.



Photograph by H. Ballise, artistic photographer. [*41 High Street, Upper Sydenham, London, S.E.*

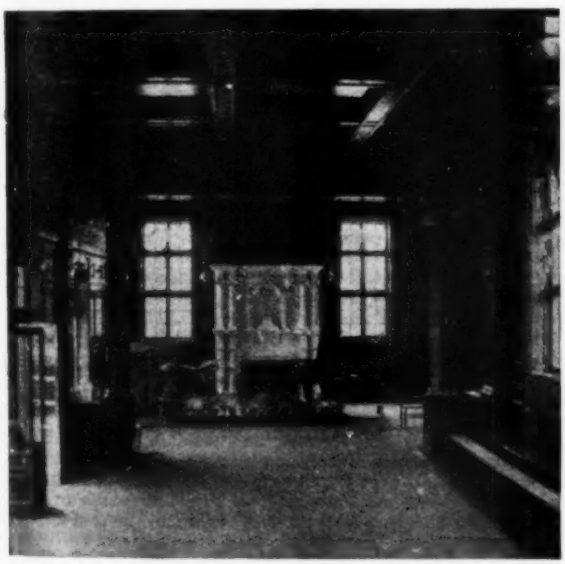
MR. J. H. DEVONSHIRE ADDRESSING THE GATHERING AT SYDENHAM.

A Red-Letter Day.

One of the first to greet the visitors on the memorable opening day was Mrs. Burgwin, happy as she always is, and intent upon making every one feel the importance of the occasion. Her speech was the feature of the proceedings. Graceful, eloquent, womanly, it brought tears to the eyes, and sent a thrill of delight through the hearts of all present. I should estimate the attendance at twelve hundred—quite a Conference gathering, by the way—and every one of the twelve hundred felt proud of the woman who has done so much for the little ones entrusted to our care. Space does not permit of printing the speeches delivered during the afternoon; nor is it possible to give the whole of the details in connection with the opening. I can only refer to some of them, and even of these but little can be said. Mr. Passmore Edwards looked, and no doubt felt, a happy man. He made a capital little speech, and received an ovation which he will remember probably to the last day of his life. And then how beautifully Madame Antoinette Sterling sang "Oh rest in the Lord!" There in the open air rang out that magnificent voice which has charmed and thrilled so many thousands. Who that heard it will ever forget it? How fitting it was that we should have with us on this all-important occasion Dr. Thomas Edmund Heller, late secretary of the Union, who laboured so incessantly in the early days of the Orphan and Benevolent Funds, and that other veteran, Mr. J. H. Devonshire, the "Father of the Orphanage," and the treasurer of the Orphan Fund from 1878 to 1899; also that Sir George Kekewich, the head of the Education Department, should be present to express his sympathy with the good work, and to pay a tribute to the Union, which he declared was a bulwark against reaction in education, and a guarantee of the freedom of the teacher! Of course we had a speech and "a story" from genial Richard Greenwood, one of the most popular of the Union's presidents, and a few welcome words from the "Father of the Orphanage," and from our president, Mr. T. Clancy, M.A. Every one will congratulate Mr. James Hodge, the indefatigable chairman of the council, and his colleagues, upon the success of the day's proceedings. The absence of the general secretary, Mr. J. H. Yoxall, M.P., and of Mr. Ernest Gray, M.P., was the only disappointment; but those of us who are closely connected with Union work recognised that it was impossible for them to be there. Every one knows, of course, that their non-attendance was not due to lack of interest. If the opening had been fixed for the 30th instead of the 23rd, both would have been present.

The Social Side of the Proceedings. After votes of thanks by Mr. Rabbits and Miss Cleghorn, tea was announced, the arrangements for which were wholly inadequate. Many were unable to obtain a cup of tea for a considerable time. It was evident that the contractors were quite unprepared for the numbers present. However, everything comes to him who waits, even a cup of tea. One felt sorry for the ladies, but a number of gentlemen came to the rescue, and did their best to obtain refreshments for them. There was sufficient for all; it was only a question of serving. However, we passed into the magnificent music saloon, where a grand concert, arranged by Mr. Ben Jonson, delighted everybody. Once more Madame Antoinette Sterling charmed us with her voice, and, of course, we begged, and begged successfully, for "Darby and Joan." Later on there was a *café chantant* in the Dell, coloured lights hanging from the trees. I must not omit to mention that throughout the day we were favoured with the services of the band of Her Majesty's Scots Guards—a great attraction, as my readers will readily understand.

Veterans in the Work. These notes would be incomplete if they did not include a reference to some of the veterans present who have not yet been mentioned. The first chairman of the Orphan Council, Mr. Richard Sykes (1879–81), Mr. W. G. Wells (1882–84, and again in 1894), Mr. E. L. Oliver (1887), Mr. C. J. Dawson (1888; also



[*Photo by T. B. Ellery.*

THE MUSIC-ROOM.

Famous for the visit of the Abbé Liszt.

chairman of the Central Committee, 1894), Mr. Robert Wild, twice president of the Union, and Mr. Langler, another president of the Union, were all there to take part in the general rejoicings. Among the younger generation were Mr. Le Manquais, chairman in 1895, and Mr. Wakerell, chairman in 1896. By some extraordinary oversight, not one of these had been invited to take a seat on the platform. There was some severe criticism during the afternoon with reference to this matter, but perhaps the less said about it the better. It was, however, to say the least of it, unfortunate. I observed, too, Mr. Russell, one of the "Old Guard," engaged in a long conversation with Sir George Kekewich—the subject, as Mr. Russell afterwards informed me, being the inadequacy of the Superannuation Act to meet the just claims of the older teachers. Here is a case of a man who has served his country faithfully for a long period of years, who has reached the age of seventy-seven, and yet for the purposes of superannuation must not count the years of service beyond sixty-five. We all recognise the hardship and injustice of this regulation. Whatever the Act might order as to future teachers, surely it ought not to say to men like my friend Mr. Russell, "You shall not reckon the years of service you have rendered after sixty-five." I can quite understand how eloquently and how forcibly the facts were presented to Sir George, and congratulate my friend upon his good fortune in having so excellent an opportunity of stating his case.

The Tenure Problem. Talking of superannuation reminds me of the tenure problem, so intimately connected with it, and of the Union's latest victory at Shoreham. It was the old story. A successful teacher, most inadequately paid, ventured to ask for an increase of salary. The final answer was a request for his resignation. Naturally, Mr. Shackleton, the teacher in question, refused to resign, and the next step was dismissal. It was in vain that he pleaded to be allowed to remain at his post until the 1st of April, so that he might be able to avail himself of the provisions of the Superannuation Act. The only possible course for the Union to adopt was to wait until the next election of the School Board, and then run Mr. Shackleton as a candidate. The election has taken place, and Mr. Shackleton has been returned at the head of the poll. Much of the credit of the victory is due to Mr. Blacker, member of the N.U.T. Executive, whose success in School Board elections is so well known. At Brighton, Plymouth, Shoreham, and elsewhere he has rendered yeoman service in this direction, and he deserves, and I am sure he will receive, the heartiest thanks of the profession for his share in this the latest of the Union victories.

Professional Backbone. A well-known School Board in the north of England now requires its assistant teachers and pupil teachers to give "criticism" lessons once a week, and even the head teachers, it is said, are called upon to give model lessons periodically. Surely this is an indignity which certificated teachers should resist. If the certificated assistant teachers in the employ of the Board are worth their salt, there should be no need for this weekly exhibition. What is the meaning of the certificate if it does not qualify the holder *to teach?* It is quite time that these impositions were resisted, and that the parties interested should show that they have professional backbone. I hope to hear that the assistants have refused to comply with this new regulation, framed, so it is said, upon the advice of a newly-appointed School Board Inspector.

TECHNICAL AND SECONDARY EDUCATION.

Welsh Intermediate Education. The Report of the Charity Commissioners on the working of the Welsh Intermediate Education Act has just been published. There are eighty-eight schools inspected and examined under the Act, all but two of which are receiving aid from the Treasury. In these eighty-eight schools the number of children inspected last year was 6,912, of whom 3,638 were boys and 3,274 girls. As an evidence of the growth of a desire for secondary education, it is of interest to know that the proportion of scholars in the schools to the whole population has increased from two per thousand to four per thousand in two years.

The teaching staff for these schools consists of 68 head-masters, 20 head-mistresses, 151 assistant masters, and 169 assistant mistresses, or 408 permanent teachers to 6,912 scholars, or one teacher to each seventeen scholars. No information is given of the status of these assistant teachers, but judging from the salaries paid, they must be considered as fairly well qualified by attainments for their position; and assuming that such is the case, it is worthy of note, and should be an incentive to School Boards to strengthen their staff, to compare the staff of qualified certificated teachers in elementary schools with that provided in intermediate schools. In Glamorganshire there is 1 certificated teacher to 116 children; in Carnarvon, 1 to 107; in Anglesey, 1 to 107; in Flint and Denbigh, 1 to 106; and the average provision in Wales is 1 to 105. It cannot be wondered at,

therefore, that one of the examiners should report that "pupils are being admitted to some of the intermediate schools who are by defective training below the standard which ought to be there maintained. The presence of this backward and laggard element cannot but injuriously affect the form-work of any school in which it is found."

Salaries in the Intermediate Schools. Seventy per cent. of the children in the county schools had proceeded thither from public elementary or higher-grade elementary schools, the county schools being to the elementary schools of the nature of continuation schools. It would seem, therefore, as if these schools provided a natural sphere for the promotion of those teachers of academic distinction and general culture whose period of probation had been served in elementary schools, and whose success warranted their transfer. That they form legitimate incentives to ambition may be seen from the fact that the average salary of a head-master is £275; of a head-mistress, £235: of an assistant master, £118; and an assistant mistress, £98. Contrast this with the salaries of teachers in elementary schools—a head-master, £142; a head-mistress, £91; an assistant master, £101; and an assistant mistress, £74. The energies of the representatives of elementary teachers on the Welsh Central Board, and on county governing bodies, may well be spent in keeping open the door of promotion to places in county schools for their brethren.

The Welsh Leaving Certificates. The Commissioners have issued regulations for the award of certificates of proficiency to the scholars in the intermediate schools. These are to be of two kinds—junior and senior; and the Commissioners hope that as the certificates will be granted only to those who have attained a certain degree of proficiency in a course of general secondary education, the system will in a short time deliver the schools from the harassing pressure of preparation for a variety of public examinations, and afford a powerful inducement to parents to keep their children longer at school, inasmuch as the certificates may become the avenue to the professions, and to commercial and industrial employment.

The first examination under the Welsh Central Board for these certificates was held in June last. The standard of qualification for a pass was high. The views of the Commissioners respecting the value of these certificates, it is believed, will be fully realised.

Assistant Teachers in Secondary Schools. The Assistant Masters' Association is growing apace, and the spirit of unionism is being developed on well-known lines. At their meeting in September they passed resolutions asking for security of tenure, pensions, and for compulsory inspection of secondary schools by inspectors who had had at least five years' experience in such schools. They received with great pleasure the decision of the Commissioners appointed to inquire into the grievances of three dismissed Grantham assistants. The decision will be of future service to these helots of the teaching profession; for it has made clear that the engagements of assistant masters are not *ipso facto* determined by the resignation of the head-master, but that, by the custom of their profession, assistants are entitled to three months' salary in lieu of notice. When secondary education comes under the control of one central authority, even these rights may be considerably extended.

Notes. During September, Sir William Harcourt opened the Ebbw Vale County School (with accommodation for sixty boys and forty girls), which has been erected at a cost of £2,600.—At Wigan a start has been made with the new Mining and Technical School, to be erected at a cost of £40,000.—A technical college is projected at Sunderland, the estimated cost being £23,000, which may in time become either a constituent college of the Durham University or a feeder to the Durham College of Science at Newcastle.—A valuable natural history collection, worth £25,000, has been presented by Mr. S. Prout Newcome to the new Technical Institute at Shoreditch.—Owens College has opened its courses of medical instruction to women, with a view to their being admitted to medical degrees. The proposition was carried at the meeting of the governors by a large majority.—A professorship of law has been established in connection with Yorkshire College at Leeds.—An interesting art exhibition has been held at the Birkbeck Institution.—Mr. Withers, principal of Borough Road Training College, has been appointed Professor of Education at Owens College, Manchester, with a view to the training of secondary as well as primary teachers in the science and art of education.—The Polytechnics in London opened on 2nd October with a larger number of candidates than in any previous year.—The Science and Art Department has for the first time published the Instructions to its Inspectors.

EDUCATION IN IRELAND.

A PERUSAL of the sixty-fifth Annual Report of the Commissioners of National Education in Ireland brings out prominently the characteristics of the country, and strikingly shows the contrasts between the conditions ruling in Ireland and those ruling in the other countries of the empire.

In the first place, the control of education is in the hands of twenty Commissioners, whose power is great and arbitrary, instead of in the hands of a Committee of the Privy Council. They report to the "Lord-Lieutenant General and General Governor of Ireland," instead of to Her Majesty. The Report is signed by the secretaries, and not, as in England, by the Lord-President and Vice-President, countersigned by the secretary. Instead of Church of England, British, Board, etc., we get Vested and Non-Vested Schools. The Code is a programme; payment by results is still in full force; the certificates of teachers are of various classes, instead of being all alike; there are no standards; the scholars are divided into Protestants and Roman Catholics; the great majority of the schools are very small, and the conditions under which education is carried on, bad as they may be in England, are infinitely worse in the sister isle.

The Schools. On September 30, 1898, there were 8,651 schools in operation, 3,816 of which were vested in Trustees or the Commissioners, and the rest non-vested. Two-thirds of the cost of the vested schools is found by the Commissioners, and the erection and improvements of the buildings are done by the Board of Public Works. It will be seen that too much money is not spent on these buildings, when it is pointed out that the Commissioners' Grant for 10,710 places was only at the rate of £2, 12s. 6d. per head; the total cost of each place being thus but one-sixth of that for each child in London. One of the chief inspectors, describing the schools in the Connaught Circuit, says: "Fair progress has been made in replacing unsuitable school-houses by proper buildings, but much still remains to be done. Of 1,596 school-houses in the circuit, 204 are returned as being *bad*, 267 as *middling*, and thus more than one-fourth are not suitable for the purpose. So with regard to the premises—157 have *no* premises, 151 have bad premises, and 237 have premises which can only be described as middling. *Bad* schools are "low-thatched buildings with earthen floors, and badly lighted and ventilated." Another description is: "Low roof, no ceiling, poor windows, shaky desks, and with fuel and caps and shawls stowed away at one end." Great improvements have been made of late years; but as the figures quoted above show, much remains to be done to bring the buildings to anything like a satisfactory condition.

In connection with the schools there are 1,270 free residences for the teachers. In some districts teachers have to walk long distances to get suitable accommodation, and in others the accommodation is often poor in the extreme. General complaint is made of the want of cleanliness in the school premises. "Children see their schoolroom walls covered with dust and cobwebs, and the floor seldom cleaned." A Chief Inspector says: "I feel it is a mercy that compulsory school attendance is merely nominal. I shudder to think of the thousands and tens of thousands of school children who would otherwise be compelled to trudge imperfectly clad to school, to find themselves in a cold, bare apartment, without a fire, or with a fire only just kindled and giving out practically not a particle of heat; the children's scanty muffling thrown all in a heap into a corner, where the wet soaks from article to article until the

whole becomes a mass of reeking moisture." "The offices in many cases are very much neglected. The air in such buildings seems to be permanently tainted, and the very walls appear to reek with effluvium. Years may elapse without these houses receiving a coat of whitewash, and the use of deodorisers or absorbents is apparently unknown." "Evidence of neglect in regard to the condition of the house and premises came frequently under my notice. It was the exception rather than the rule to find matters otherwise." On the other hand, one inspector says, "The teachers as a body deserve much credit for the care and attention which they bestow in keeping the school-houses and premises in order." Why should it be the duty of the teacher to see to the heating, lighting, and cleaning of the school-house?

Attendance. Accommodation is provided in the schools for 867,619 pupils, allowing eight square feet per child: 808,467 children, of ages varying from three to fifteen, were in these schools. The average attendance was 518,799, or 64·2 per cent. only. In England 81 per cent. is considered bad enough, yet Ireland, for the first time, has reached 64! If payment by results was wrong in England, it surely is doubly wrong where the percentage is as low as in Ireland. The religious denominations to which the scholars belong are stated, and the schools are attended solely by Roman Catholics, solely by Protestants, or by both Protestants and Roman Catholics. In the latter case, the teachers are also of varying religious beliefs. The Irish Education Act of 1892 provided for the adoption of compulsory clauses by the localities. In thirty-six places the provisions have been put into force, with the result that the average attendance in those places is 71·1 per cent., as against 64·2 for the country generally. It is quite common in some of the districts to find persons of sixteen, eighteen, or even more years of age in the schools. There are thirty model schools in Dublin and the different school districts. These are supposed to be models the other schools should imitate, and are wholly maintained by the State.

A peculiar feature of Irish education is the existence of a large number of convent and monastery schools taught by monks, nuns, and lay assistants. Many of these schools are spoken very highly of by the inspectors, and the results obtained are often superior to those of the ordinary National schools; but attendance at them is not much higher than the average.

The Teachers. The profession of teacher is in many districts much sought after. The pay is regular and much higher than that obtained by farmers and tradesmen. The way to the profession is through "monitorship" or "pupil teachership," and the passing of examinations. The certificated teachers are of three classes, each having two divisions, 2,815 being in the first class (entrance to which is only obtained by distinction in examinations and highly meritorious service), 5,358 in the second class, and 3,802 in the third class. Forty-six per cent. of them have been trained for one or two years in one or other of the five training colleges, all of which are in Dublin. The masters number 1,989, the mistresses 2,277. In most cases the inspectors—and every inspector writes a report—speak well of the teachers. The Chief Inspector speaks of "the great improvements in the *personnel* of the teaching staff." To express fully his meaning, he says, "The modern teachers are far more ladies and gentlemen than were their predecessors. I do not mean that they come from a higher social class—though that, too, is probably the case—but in all the civilities and courtesies and refinements of life they occupy a higher level, and in intellectual and literary culture a still higher level." At the same time, the inspectors speak freely of their faults and want of preparation of lessons, and want of zeal and earnestness—"There is a certain percentage whose retirement would be a public benefit." All the virtues it is impossible to get for less than a pound a week, which is more than the "fixed" salary of upwards of a third of the teachers. True, some addition is made from "results" grants: but as the schools are small, it does not amount to much, at least for third-class teachers.

Management. The one-man manager is common in Ireland. If he is sympathetic, it is well for the teacher; if not, cases like Mrs. Sullivan's are numerous, but are kept in the dark. The one-man manager is the cause of the present disaffection and disorganisation in the Irish Teachers' National Organisation. The following is typical of all Ireland. In one district 109 schools are managed by 29 Roman Catholic priests, 25 by 18 Irish Church clergymen, 4 by three Presbyterian ministers, 8 by five nuns, 3 by one monk, 5 by three officials, 2 by two laymen, 1 by a Methodist minister. Thus, 62 persons manage 157 schools, or nearly three schools to each person. In another district 59 persons manage 148 schools. The managers do not always do their duty. The condition of the schools should be their chief concern, but, as has already been pointed out, this leaves much to be desired.

Finance. How are the schools financed? If vested, two-thirds of the cost of the buildings is met by the Commissioners, and even in other cases some help is given. For maintenance, 96·7 per cent. of the cost of the teaching staff is found by the Imperial Exchequer, and only 3·3 per cent. by the locality. The other expenses are merely nominal, and fall upon the localities, the subscribers, the managers, and very often the teacher, who out of his scanty salary is often responsible for books, fuel, and other requisites. The total amount of fees is but £7,182 for the 808,467 children. If teachers in England were paid by the State in the same ratio as in Ireland, the rates would quickly vanish and the Imperial burdens become somewhat heavier. The cost of the teaching staff to the State is at the rate of £2, 4s. 2½d. per child in average attendance. Out of a total expenditure from public funds of £1,321,777, only £8,737 came from rates, while voluntary contributions yielded £22,876. Here, if anywhere, there is therefore a National system. But whatever may be the cause, the system cannot be said to be over-successful.

The Subjects taught. They embrace more or less all the subjects taught in English schools, but a few industrial pursuits are peculiar to Ireland. Net-mending, beekeeping, management of poultry, advanced dressmaking, dairy management, and woolspinning, are among the specific subjects taught besides those of Schedule III. of the English Code. Every class, from the fourth to the seventh, must know something of agriculture, and there is no doubt that by this means, and the Agricultural Schools, much improvement in tillage and farm work will take place ere long.

The report is crowded with the opinions of the inspectors upon almost every subject of school-work—upon the teachers' conduct, zeal, ability, the use of their spare time, intellectual and professional capabilities. Many of the criticisms, from personal knowledge, we know are true, and kindly meant, but accurate. The adoption of some of the recommendations of the Commissioners on Technical Education, the whole or partial removal of the "results" system, the provision of better buildings, better apparatus, and other reforms, are needed before Ireland is known as the home of a great and good educational system. Nevertheless, there is no difficulty in agreeing with Mr. C. Smith, the District Inspector for Cork, "that primary education is advancing, that its illuminating circle is spreading more and more every year, but the advance is slow when one is obliged to put on record that 30 per cent. of those on the rolls fail to attend on 100 days in the year, and that 20 per cent. of those examined are presented in the fifth and sixth classes, and that hundreds of children never go to school at all. I believe the time has come for the adoption of heroic measures for the extension of primary education, if the many who wander in darkness are to be brought within the sphere of its kindly refining light."

NOTES FROM THE NORTH.

President of Moray House Club. We regret that the photograph of Mr. Wm. Anderson, President of the Moray House Club, was received too late for inclusion in last month's notes on the September meetings. We have pleasure, however, in giving it this month. Mr. Anderson is head-master of West Bridgend School, Dumbarton, and has been for the last two years a member of the General Committee of the Educational Institute.

Changes in the Inspectorate. By the death of Dr. Robert Ogilvie, Chief Inspector of Schools, and of Mr. J. W. Marshall, Inspector of the Ayr District, considerable changes have been made in the districts of the inspectors. From December 1, 1899, Dr. T. Stewart, at present Chief Inspector

MR. WM. ANDERSON.
(*President, Moray House Club.*)

of the Western District, is to be transferred to Edinburgh, as Chief Inspector of Schools in Scotland and of the Training Colleges. Mr. A. E. Scougal, who has at present charge of the East and Mid Lothian District, succeeds him in Glasgow. Mr. A. O. Barrie (a brother of the novelist, by the way), Inspector of the Dumfries District, succeeds Mr. Scougal. Mr. F. R. Jamieson, at present in the Glasgow District, succeeds Mr. Barrie. Mr. A. Lobban, who is in charge of Banffshire and Orkney, is to take the place of the late Mr. Marshall. Mr. J. M. Wattie, of the Edinburgh District, succeeds Mr. Lobban. The two newly-appointed inspectors, Mr. J. C. Smith, M.A. (Edin. and Oxon.), rector of Stirling High School, and Mr. A. Douglas Thomson, M.A., D.Litt. (Edin.), are to fill the vacant places in Edinburgh and Glasgow respectively.

The late Dr. James Smith, ex-Secretary of the Institute. Mr. Thomson, ex-President, in his retiring address at the September meeting, referred to the serious loss the Institute had sustained during the past year in the death of Dr. T. Morrison, the genial teacher, and of Dr. H. Campbell, the perfervid orator, and in the severe illness of Dr. D. Ross, the able administrator. To that list has now to be added another of the most enthusiastic supporters of the Institute, and one whose works are largely written in its annals. We refer to Dr. James Smith, ex-Secretary of the Institute, whose death took place on Friday, 6th October.

Dr. Smith, who was in his seventy-eighth year, was born at Mauchline, in Ayrshire, and received his education at the academy of the county town. Garlieston, on the shores of the Solway, Whiteletts, in Ayrshire, and Symington, in Lanark, were successively the scenes of his early labours as the head-master of the Free Church schools in these respective localities.

DR. JAMES SMITH.

But Uddingston is associated in the minds of most teachers with the ex-secretary. He was head-master of the Free Church School there from 1847 to the passing of the Education Act, when both he and his school were taken over by the School Board. Dr. Smith retired from that position in 1893, on account of advancing years. In 1894 the University of Glasgow conferred on him the degree of LL.D., in recognition of the great work he had done for the Institute. Not content with his professional work, he took a keen and public-spirited interest in local affairs, and a few years ago he was appointed a Justice of the Peace.

In 1847 Dr. Smith identified himself with the movement for the organisation of teachers into a corporate body. Since that time he always took a deep and active interest in its affairs. In 1866 the Institute so highly approved of the work he had done that they elected him president; and in 1873 he was appointed to the important and onerous position of secretary. To him is due the idea of holding congresses at Christmas, and to him fell the initiation of the now successful scheme. His knowledge of the business of the Institute was most intimate, and to him in large measure is due any success it may have achieved during the earlier years of its history. In 1896, on his retirement from the secretaryship, he was presented with a purse of sovereigns and a handsome silver tray, in recognition of twenty-three years of faithful service in the general secretaryship, during which he had done much to advance the cause of education generally, and at the same time the interests of the Educational Institute of Scotland. In his words of acceptance he concluded by saying: "Allow me, for the sake of my younger brethren, to state that during all these years I have never on any account been absent from a single meeting at which I had a right to be present, whether of the general body or of my local association; and that regularity at these meetings does not tend to shorten the life, injure the health, or damage the reputation." In that year, Dr. Smith, for his long and faithful services, was granted a retiring allowance of forty pounds annually, with the title of honorary secretary, and with the position of assessor to the General Committee of Management of the Institute. At the meeting of the General Committee of Management on 14th October, it was agreed to engross in the minutes an expression of the great loss the Institute had sustained.

Commercial Education. The question of commercial education is at present the subject of much discussion at the various Chambers of Commerce throughout Scotland. Some time ago the propriety of the Chamber of Commerce in Glasgow taking steps to organise a system of commercial education and examination, and of granting certificates of proficiency, was urged by Dr. William Jacks. A committee was formed for this purpose, and this month the report was submitted. The report considered, first, the desirability of the Chamber of Commerce granting certificates for commercial education; and second, if considered desirable, the proposal of a scheme.

With reference to the first of these, the committee thought there could be no question but that such certificates were very desirable. The fact that foreign nations are forging ahead of us is in large measure due to the want of a proper commercial training on the part of British youths. Another reason adduced is that considerable inconvenience is caused, both to clerks and employers, through want of proper machinery for supplying the demand. The possession of such a certificate would be a guarantee that the holder of such certificate was perfectly qualified in the attainments therein specified.

With regard to the examining body, it was proposed to accept the certificates either of the Scottish Educational Board or of the Society of Arts in London, provided they would examine the candidates, having regard to the objects which the Chamber of Commerce has in view. The meeting held to discuss the report suggested that the matter should be sent back to the committee, and that representatives of the leading educational institutions in Glasgow should be invited to confer with the committee. Is there not here an opportunity for the Educational Institute of Scotland adopting the suggestion of the ex-President of the Institute in his closing address? He said: "I think we should open negotiations with the Chambers of Commerce in our chief cities for the framing of a commercial certificate, such as ought to form a passport to all the better positions in our mercantile offices." We trust to see, therefore, the Educational Institute of Scotland making overtures to the

various Chambers of Commerce at once. The question is one of paramount importance to the Institute, for this would help to make it become (as it ought to be) the Examination Board for Scotland. It has now conducted for some years the examinations in connection with the medical profession. The Veterinary College, too, has entered into arrangements with the Institute for the conducting of its examination. The Pharmaceutical Society has lately approached the Institute for a similar purpose.

FOREIGN NOTES.

BY E. E. FOURNIER D'ALBE, B.SC., A.R.C.S.

In his recent address before the Prussian Academy, on "Leibnitz and the Problem of a Universal Language," Professor Diels gave several reasons why English was destined to become the international business language. First of all, it is a happy blend of the Teutonic and the Latin idioms; further, it has discarded most of the complex accidence which makes other languages difficult to acquire; and lastly, it has already the numerical superiority over its three greatest rivals—French, German, and Spanish. At the same time, the professor does not consider that any of the four languages hitherto used for the publication of scientific work—namely, English, German, French, and Italian—is capable of superseding the others in that department, and he therefore advocates the reintroduction of Latin as the language of science and international culture. The invention of an artificial language he considers altogether hopeless.

* * * * * *

Now, in forecasting the ultimate triumph of English as the universal language of commerce, the displacement of the other languages must not be taken as implied. At successive periods of the world's history, Assyrian, Greek, Latin, and French have been all but universally accepted as international media of culture. And yet in these latter days of intense world intercourse the national languages are more cultivated, and indeed more isolated, than ever before. New languages are fashioning themselves every year, or are being revived and embodied in a literature of their own. The adoption of an international language would facilitate, instead of discouraging, the development of the smaller national languages, like Greek, Bohemian, Welsh, etc.; since, in order to march with the times, while retaining its own individuality and self-respect, each smaller nation will only consider itself bound to acquire one foreign language, instead of a number of them, in addition to its own.

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The leading educational magazine of South America, *The Boletin de Enseñanza Primaria* (Monte Video), contains, among a variety of fine contributions, an interesting study by P. de Alcantara Garcia on the origin and formation of the Castilian language. He traces the growth and development of Spanish from its Celtiberian root through the Roman conquest, the Gothic invasion, the Moorish occupation, and the Castilian renascence. "Sweet, but not effeminate; severe without rudeness; sonorous and grandiloquent; flexible to a degree; rounded and grave in prose, full of richness and harmony in verse—our language rivals Italian, surpasses French, and falls short in its perfection of Latin alone." And really, in reading the learned author's well-turned phrases, one feels that he is not very far wrong. Even now, when Spain is shorn of her imperial possessions, the language of Cervantes and Calderon is full of grace and vigour, and as a world-language yields to English only.

* * * * * *

Much has been said of the importance of vernacular literature as a means of educating the Indian masses. The Dravida Basha Sangham is making an effort to supply a high class of vernacular literature in the four principal Dravidian languages—Tamil, Telugu, Malayalam, and Canarese. The Graduates' Trading Association, Mysore, has been unostentatiously producing a good number of works in Canarese, both original and translations. They include prose adaptations of Shakespeare's *Tempest*, *Pericles*, and *As You Like It*; *Rajasimha*, a historical novel; *Ananda Matha*, a novel founded on the Sannayasi rebellion; *Kapala Kundala*, a weird romance; an illustrated Natural History; an illustrated botanical work; *Sitavanavas* (Exile of Sita); *Rajani*, a psychological romance; *Morad the Unlucky*; *Peter the Great*; *Book of Songs for Girls*; *Modern Story of Bengal*; novelettes, etc., etc. This development will serve to open out to the natives those literary treasures which are best adapted to their needs and environment.

* * * * * *

The Marquis of Gravina has made to the University of Catania the unusual present of a small archipelago, part of the Cyclopean Isles, off the coast of Sicily. In July last the present rector of the university took formal possession of the islets. They have an almost tropical vegetation, and are distinguished by their peculiar marine fauna and a highly interesting geological structure, marked by a number of rare minerals. It is said that the university authorities intend to establish laboratories for geological, mineralogical, and biological research on their new property.

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The "Berlin Society for the Encouragement of Flower-growing among Children" can look back upon two years' activity with great satisfaction. In a large city like Berlin it is very necessary that the children should have some compensation for the want of facilities for coming into contact with living nature. So the society annually distributes shoots and cuttings of flowering plants among the children, and at the end of the summer exhibits the flowers developed under their care. Some 10,000 people visited the last exhibition, which proved a great success. A number of small prizes were then distributed. The effect upon the children is said to be very wholesome and happy.

* * * * * *

Some sensation has been caused in Prussian educational circles by the resignation of the Minister of Education, or, as he is technically termed, the Minister of Spiritual, Educational, and Medicinal Affairs. Dr. Bosse has held the portfolio for over seven years. He has been the most notable, and on the whole the most popular, Minister of Education since the famous Dr. Falk. Last year he pushed a Bill for the regulation of teachers' salaries through all its stages with great energy, and thus earned the thanks of all Prussian teachers. It is rumoured that his retirement, although distinguished by every mark of esteem, is due to personal differences with the all-powerful Finance Minister, Von Miguel.

* * * * * *

A curious old custom survives in some of the rural districts of Prussia. The village teacher is bound to call the workmen of the landlord together in the morning, and to personally announce the commencement of divine service at the house. A case of refusal on the part of a teacher was recently dealt with at Frankfort-on-the-Oder. The recalcitrant teacher pleaded that the service in question was formerly rewarded by the customary grant of a drink of brandy and a slice of bread-and-butter, and that this side of the bargain had lately fallen into disuse. And so the Government also cancelled the teacher's part of the contract.

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NOTES OF TWO LESSONS.

By WILLIAM DONE, B.A., *Head-Master of Brighton Pupil Teachers' School.*

(In the Scheme of Lessons of Circular 369—VII. Object Lessons in the Science of Common Things.)

Articles of Illustration.—Some specimens of chalk; quicklime; a Bunsen burner, and blowpipe; some dilute acid, and simple apparatus for making carbonic-acid gas; a candle; weighing apparatus or common balance. If a microscope is at hand, two slides, showing respectively a thin chalk section and some globigerina ooze, would be very effective; otherwise two diagrams could be prepared for this purpose.

I.—CHALK.

OBSERVATION AND EXPERIMENT.	TRUTH TAUGHT.
1. Take a piece of chalk, rub it gently so as to make a very fine powder. Spread a little of this on a wet glass slide, and place it under the microscope.	Chalk seems to consist principally of the skeletons of very lowly animals, and the chalk cliffs of the present day and the mud now forming at the bottom of the sea are practically the same substance.
2. Take a second slide showing the white ooze forming on the bottom of the Atlantic at the present day. Ask for places where chalk cliffs are found—Dover, Beachy Head, etc. Comment on the thickness of such chalk masses, and on the tiny skeletons composing them. Refer also to other chalk regions, as the Downs of England, similar districts in Northern France, Germany, etc.	(*a*) It must have taken many ages for the ooze to accumulate. (*b*) The chalk cliffs must once have been under the sea. A great part of Central Europe was once under the sea, and the earth's surface has suffered much alteration of elevation and depression.
3. Take a piece of plaster of Paris, which might easily be mistaken by the class for chalk, and pour some dilute acid upon it. Take a piece of chalk and treat it in a similar way.	The acid had apparently no effect on the gypsum, but the action on the chalk was very evident by the fizzing sound that ensued.
4. Place some pieces of chalk or marble, or any other kind of limestone, in the apparatus for making carbonic-acid gas; pour dilute acid on the substance, and collect the gas by downward displacement. Let some of the gas bubble into water, to convince the class that it is coming off. Take the jar of CO_2 and decant it into another jar which is placed in the balance previously and equipoised.	The effect of the acid is to liberate a gas from the chalk, which is heavier than air, for it can be collected downwards, driving out the air from the collecting jar. This gas can be poured again into a jar of air on the balance, and destroy the effect of the counterpoise. We may thus weigh our jar of new gas.
5. Place a lighted candle or wood splinter in the CO_2. Give the name of the gas.	The new gas will not support combustion, and is not in itself combustible.
6. Hold a piece of chalk in the blowpipe flame of the Bunsen burner. When it is sufficiently reduced, compare its colour and hardness with that of the chalk itself.	Strong heat applied to the chalk causes it to lose weight, to alter its colour to a yellowish white, and makes the substance liable to crumble.

II.—LIME.

OBSERVATION AND EXPERIMENT.	TRUTH TAUGHT.
1. Take the substance just formed by means of the blowpipe, and contrast with a piece of quicklime obtained before the lesson.	The two substances seem the same in colour and liability to crumble. (Tell the class they are identical.)
2. Take a very small piece indeed of the quicklime and shake it up in a large bottle of water.	The piece of quicklime has almost or perhaps quite disappeared, showing that it is soluble in water. (Give the name—lime-water.)
3. From the carbonic-acid gas apparatus bubble some gas into the lime-water.	The lime-water turns milky. (Tell them that we have practically composed limestone again.) Limestone, or any of its varieties, such as chalk or marble, is made of quicklime and carbonic-acid gas.
4. Place some quicklime on a plate or saucer. Add a little water. Ask where they have noticed similar results on a large scale. Refer to workmen warming their cans of tea and coffee.	The water apparently does not make the quicklime wet, but causes it to crumble still more readily. Heat is evolved, as witnessed by the smoke, which is apparently some of the water passing away again as steam.
The substance at last breaks up to a powder, but is still dry.	(Give the name—slaked lime.) Slaked lime is quicklime with a certain amount of water.
5. Continue to add water gently until a thin paste is formed.	There is no longer a hissing sound produced after the lime has gone to a powder, so slaked lime is different from quicklime.
6. Ask for what purpose the workmen slake lime. What do they add to the resulting thin paste?	Mortar is a mixture of slaked lime and sand.
7. Mortar after a time gets hard. Refer to the presence of carbonic-acid gas in the air. Compare a piece of old mortar with a piece of limestone.	Apparently the carbonic-acid gas from the air slowly impregnates the mixture of lime and sand, and forms a hard mass like the limestone, but with the additional binding influence of the sand.

Summary of the Lessons.—Chalk is a variety of limestone, and is chiefly composed of the skeletons and shells of organisms which secreted calcium carbonate.

The same substance is being formed to-day at the bottom of the great oceans, and usually bears the name of white ooze.

Limestone is composed chemically of quicklime and carbonic-acid gas.

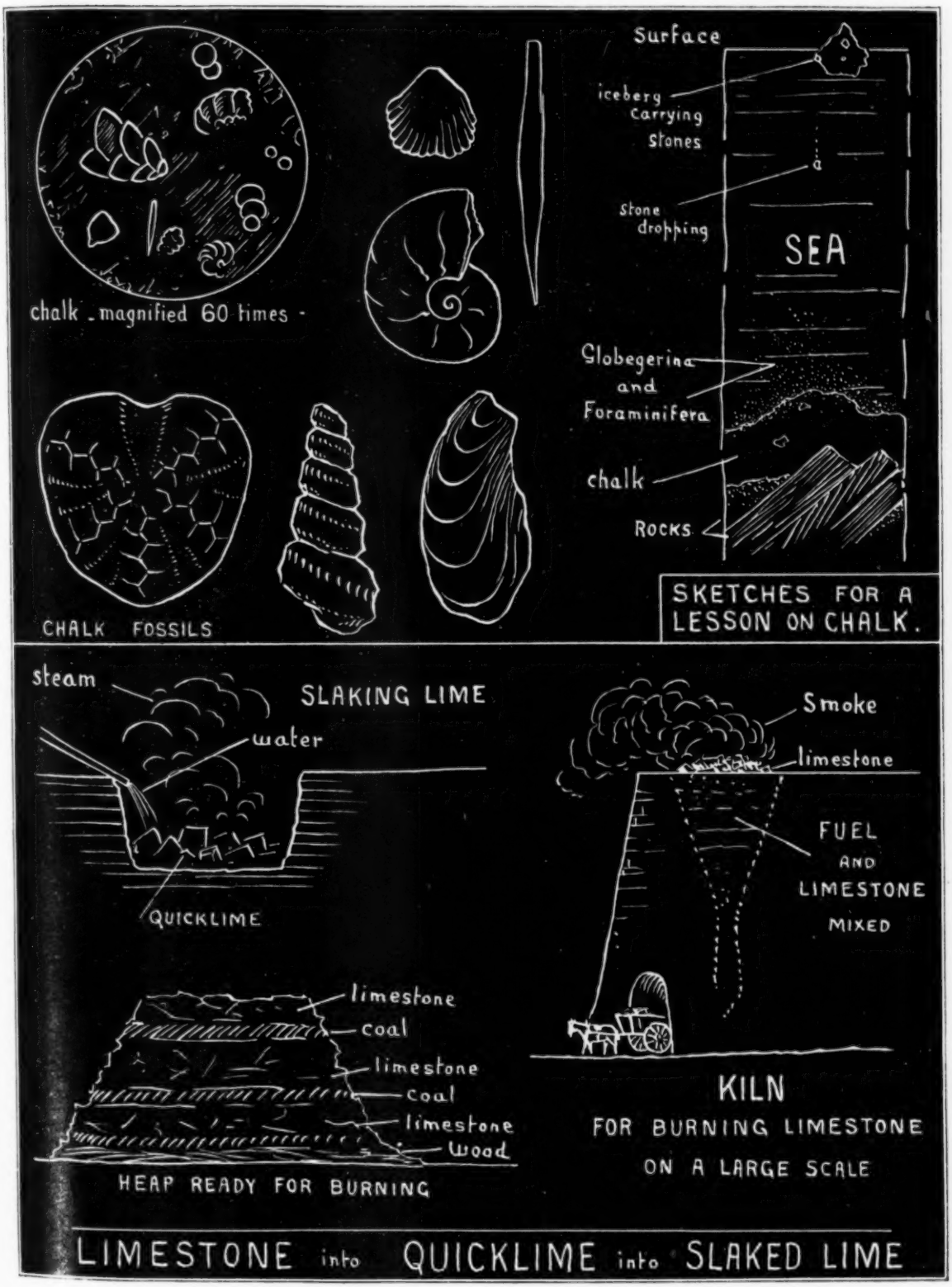
Quicklime is a yellowish-white solid; it combines with water, giving off much heat, and forms a powder called slaked lime.

Carbonic-acid gas is heavier than air.

Slaked lime with water and sand forms mortar, which sets by absorbing carbonic-acid gas.

BLACKBOARD ILLUSTRATION.

BY C. ARMSTRONG, EXAMINER TO DEPARTMENT OF SCIENCE AND ART.



PRACTICAL ELEMENTARY SCIENCE.

AN EXPERIMENTAL COURSE COVERING THE REQUIREMENTS OF BOTH THE DAY AND EVENING SCHOOL CODES IN PHYSICS AND CHEMISTRY.

BY THOMAS CARTWRIGHT, B.A., B.SC.,

Author of "Practical Chemistry," "'Section One' Physiography," etc.

TO teach science properly is to teach it experimentally. This cannot be too often or too much insisted upon. Moreover, it must not be thought that good practical work is possible only in a perfectly-equipped laboratory. Berzelius, the great Swedish chemist, who achieved more than perhaps any other worker in the way of accurate determinations, worked in a kitchen with the simplest of appliances; and although we may not all hope to emulate Berzelius, it is certain that we can do much in the way of practical work without elaborate and expensive apparatus.

An Example.—Here is a case in point coming within the range of the writer's experience. Suppose it is desired to show (1) that lime is formed from limestone, chalk, or marble; (2) to make lime-water; (3) to show that carbon dioxide is got from washing-soda by the action of acids upon it; and (4) that carbon dioxide turns lime-water milky. The sybaritic worker would ask for a muffle furnace to convert the limestone into lime, a Woulffe's bottle fitted with thistle funnel and delivery tube to prepare the carbon dioxide, and so on; whereas the work can be done in an inexpensive way by each pupil in his own home. Tell each boy to get a piece of marble, or provide him with a piece, if he is not sufficiently enterprising to get it for himself, and instruct him to put it in the middle of a good fire, there to remain for about half an hour, or as much longer as desired. The limestone is then to be taken out with the tongs, and to be allowed to cool, when it is put into a cup of water. The effervescence that follows will show that lime, and not marble, has been placed in the water; and after the solid lime has been allowed to settle, the lime-water may be poured off, or decanted as it is best called. Breathing into a portion of this clear lime-water, contained in a wine-glass, through a clean clay tobacco-pipe stem or a bit of glass tubing, will produce the milkiness that testifies to the presence of lime-water in the glass, and of carbon dioxide in the breath. If now a piece of washing-soda is placed in a wine-glass, or, better still, a small, narrow flower-vase, and some vinegar be poured upon the lump of soda, the gas that comes off may be poured into the lime-water without tilting the vase sufficiently to permit any of the liquid to flow out, and upon shaking, the lime-water will exhibit the characteristic milkiness the appearance of which is our proof of the presence of carbon dioxide.

This is a very crude experiment, it is true, but it amply suffices to prove that carbon dioxide is contained in soda, and that this gas is heavier than water, and able to turn lime-water milky.

As experience is garnered, the teacher will be able to multiply these simple experiments indefinitely, and he will be surprised how little is absolutely necessary in the way of equipment in order to do justice to an experimental course in simple natural phenomena. There is one notable exception to this statement to which the attention of the teacher must be called. It is with respect to the balance, which must be reliable, and which, when obtained, must be treated with the utmost care. The knife-edges in particular must be used most tenderly. If they are made of agate, they will chip upon very small provocation; if, on the other hand, they are of steel, beware of the enemy rust. On the whole, we think best of the steel knife-edge, which should be periodically oiled, the oil being rubbed off until only the thinnest layer remains upon the edge of the steel wedge, so that there is no fear of stickiness interfering with the poising of the balance. A balance sufficiently good for all simple purposes can be got for about thirty shillings, and with proper care it should last for many years.

The present course is intended to supply practical work in illustration of the simple principles of science, a knowledge of which is required from the students of the evening continuation school who take the subject Physics and Chemistry, and from the day-school pupils taking Specific Subject No. 13, also called Physics and Chemistry. It is suggested that the instruction should go as far as possible on inductive lines, the pupil being set *to discover some truth;* but he who thinks that it is possible to make much progress by means of inductive work pure and simple, imagines a vain thing, and shows little acquaintance with the instruction of students in the elements of science. Hence we would encourage the teacher to do some amount of telling, and to be satisfied when his pupils have to some extent verified, by appropriate experiments, the dogma thus delivered. We know that Professor Armstrong, who has done much for the advancement of the experimental teaching of science, holds a contrary opinion, and claims that the inductive or heuristic (to quote the term used by him) teaching is capable of everything without recourse to deduction; but Professor Armstrong knows nothing of the teaching of children, or he would soon alter his opinion. Our course, then, will be mainly inductive, becoming, however, deductive as occasion demands.

The syllabus is not an ideal one, and will require emendation at our hands, but in the main we shall adhere to it; so the teacher in following the programme mapped out in these articles will be teaching in accordance with Departmental requirements.

THE SYLLABUS.

Day School. *Stage I.*	Evening Continuation School. *Part I.*
Properties of common stuffs. Relative density of solids and liquids. Flotation of solids. The barometer and thermometer—their use; graphic representation of daily readings. Solution: water as a solvent. Solubility of metals, etc., in acids. Crystallisation of salt, soda, alum.	Measurement. English and French standards of length. Areas and volumes. English and French weights. Balance. Graphic representation of weights of cubes by lines. Relative weights, compared with water, of common substances by the balance and by the U-tube. The barometer a U-tube. Thermometer. Evaporation. Distillation. Solubility of substances in water. The measurement of heat as a quantity. Heat capacity.

Matter.—In treating of the "Properties of Common Stuffs," we must (1) define stuff or matter; (2) distinguish between solids, liquids, and gases; and (3) investigate (*a*) the properties common to solids, liquids, and gases (that is, to matter in all its forms—the **general properties of matter**), and (*b*) the special properties of solids, liquids, and gases.

1. **Definition of Matter.**—Exhibit a number of articles, such as chalk, wood, a tumbler, a bell, salt, sugar, and flasks containing coal gas and ammonia gas, an onion, and a bottle of smelling-salts. Let the children close their eyes and smell the onion, the coal gas, and the ammonia. Do they know that these substances are present? They will reply that they do, because they can *smell* them. Then one way of becoming aware of the presence of things is by smelling them. With the eyes still closed, let each pupil take in his hands one or other of the substances named. How now do they know of the existence of these things? Because they can *feel* them. Whilst eyes are still closed, let the bell be sounded, and also let some one knock at the door or on the table; and again ask the pupils if they are sure that there is a bell present, and that somebody has knocked at the door. We know of the existence of some things by the help of the *ear*. Next let each child place a piece of salt, sugar, or other substance having a strong flavour, in the mouth. How do they know now of the existence of the substance? By the *taste*. Now, with eyes opened, let the pupil be called upon to name the various articles that are on the table or in the room. How do they know this? They can *see* them. These and similar experiments should be multiplied, until the pupils thoroughly understand that *we get our knowledge of stuff, substance, bodies, objects, or matter by way of the senses of sight, touch, taste, hearing, smell,* and so lead up to the definition: **Matter is that which causes our senses to be affected.**

We now proceed to educe that **matter occupies space.** This will be readily admitted by the pupils with respect to solids and liquids, so the teacher will proceed to deal with gases. The pupils should all, either singly or simultaneously, press a tumbler, mouth downwards, into some water, and the question should be asked, "Why does not the water completely fill the tumbler?" The same experiment should be performed with coal gas in place of air, and the pupil should be told that although this same truth cannot be shown to be true of all gases when water is the liquid employed, still by the employment of suitable liquids the truth that *gases occupy space* may be shown to be universal. We have now two tests whereby we may ascertain whether or not a thing is material or immaterial, and a brisk questioning should now follow, in order to ensure that the pupil has a correct notion of matter in his mind. He may, for example, be asked whether or not love, hatred, strength, and heat are matter; and likewise whether and why clouds, winds, rain, etc., are matter. The puzzle here will be to distinguish between material and immaterial things; and the teacher will be wise in telling his pupils that matter is not the only *thing* in existence, for there are immaterial things, such as strength, heat, and light; and if the children are puzzled, as they probably will be, the difficulty will easily be surmounted by telling the pupils that all matter has weight, whereas immaterial things have no weight; and the absurdity of speaking of a pound of light, an ounce of heat, or a hundredweight of love will be sufficiently apparent. Furthermore, the pupil should be told that experiments will later on be performed showing that a piece of platinum or iron weighs exactly the same when hot as when cold.

Cohesion.—Before studying the properties of matter, it will be best to arrive at a knowledge of the differences between solids, liquids, and gases. Accordingly we start with the force of cohesion. A piece of chalk is shown to the class, and the pupils are asked why it does not fall to pieces, the same question being asked with respect to other common solids. There is evidently some power at work in consequence of which the particles of chalk are held together, and the same is true of all other bodies. This force is called cohesion, and it only acts between particles that are alike. Break the piece of chalk, and press the broken pieces together. Why do they not stick? Get a magnifying-glass, and let the pupils see that the broken surfaces are exceedingly jagged, so much so that it is impossible so to fix the broken parts as to get the chalk in contact everywhere; and this is why the chalk cannot again be made intact. Show a piece of black-lead pencil. Remove the wood, and exhibit the piece of solid plumbago with which the writing is done. Tell the children that this was made from a fine powder which, by being pressed together, was made to cohere. Also inform the class that two pieces of smooth plate-glass, when pressed together, are joined so tightly as to make it impossible to separate them. The smoothness of the surfaces of the plate-glass must be enlarged upon, and must be brought into sharp contrast with the jagged nature of the broken chalk surfaces. It ought now to be plain that before this "holding-together force" can act, the particles must be close together. Hence the idea of **cohesion** as **a force acting between particles of the same kind when in contact** should now have been obtained. It will be advisable to speak of **adhesion,** especially as it will help to fix more clearly the need for contact in cases of cohesion. A postage stamp should be affixed to paper by the children, a leathern sucker should be moistened and be made to stick to the wall, and some mortar should be plastered on to a couple of bricks, which should then be brought together. Why does the stamp stick to the paper? Because of the gum. There is evidently a sticking power in gum, and it acts on substances dissimilar to itself, but still in contact. The same applies to mortar. Why must both the gum and the mortar be moistened? Because the contact between the gum and the paper, and the mortar and the bricks, must be as intimate as possible if sticking is to be accomplished. The name **adhesion** is given to this sticking-together force which acts between dissimilar substances when they are in contact; and it is worthy of note that the mortar adheres to the bricks, and that the particles of the mortar cohere together.

Application to Solids, Liquids, and Gases: Solids.—It will be plain from what has preceded that cohesion is very great in solids. An attempt should now be made to show that in consequence of this both the **shape** and the **size** of solid objects are definite. If you remove all support from the piece of chalk, for example, and also if you change its temperature, making it either hotter or colder, both shape and size are maintained, because the cohesive force is not affected by either of these changes. Insist upon the fact that we always refer to the shape of solid substances—for example, we say a piece of coal shaped like a brick. We should never describe solids by referring to their shape if shape were not a permanent quality. The definition may now be got that "a solid body is one that has a definite size (or volume) and shape, because of the force of cohesion, that will not let the particles be easily separated."

Liquids.—The pupils should now be asked to spoon out some water or other liquid from a vessel, such as a tumbler, containing it. Do they find it difficult to get a part of the liquid away from the whole? What does this teach concerning the force of cohesion in liquids? Let each pupil pour out some of the liquid. Why can it be poured out so readily? The particles of a liquid certainly do not hold together very firmly. *Cohesion is weak in liquids.* Do we ever speak of the *shape* of liquids? The class will soon see that the shape of a liquid is that of the vessel containing it—that is, *liquids have no shape of their own.* Now as to volume. Does this change of itself if the liquid is left standing?

Next improvise a piston by supplying each pupil with a bottle provided with a well-fitting stopper. Fill the bottle up to the top with water, and try to compress the water so as to get the stopper in without letting any of the water escape. It is impossible so to compress the water, as has been shown by most careful experiments of this kind, for *liquids are incompressible fluids.* We may now define liquids as **incompressible fluids having a definite volume but no definite shape;** and by careful questioning it should be ascertained whether or not the pupils understand that this is due to the weakness of cohesion in liquid matter.

The gas should be turned on for a second, or the stopper should be taken out of a bottle containing smelling-salts, ammonia, carbon disulphide, or any volatile gas. How is it that the gas fills the whole of the place so speedily? Is it because the particles hold firmly together? The pupil will hardly fail to see that the particles must tend to separate from each other rather than to hold together, as so small a portion penetrates so large a space in so short a time. Hence the particles in a gas are said to repel rather than to attract each other. Cohesion is non-existent in gases. It will need no argument to show that gases have no shape; and to prove that they have no fixed volume, it is only necessary to fill a vessel with gaseous ammonia, and to leave it open for a short time. It will be clear that the volume of the ammonia is now that of the room; for we say, "The room is full of ammonia." Let the children repeat the experiment of trying to fill a tumbler with water by pressing it vertically downwards with the mouth underneath. At the commencement the tumbler was manifestly full of air. How is it that the water has now partly taken the place of the air? Is there less air than at first? A few questions of this description will elicit the answer that **gases are compressible fluids.** We call both liquids and gases fluids because they "flow" from one vessel to another. The following tabular statement of differences will now be useful:—

	Solids.	Liquids.	Gases.
Cohesion....	At a maximum.	Much weaker.	Non-existent.
Shape.....	Definite.	None except that of containing vessel.	None.
Volume.....	Fixed.	Fixed.	Varies greatly.
Compressibility.....	Slight.	None.	Very great.

ELEMENTARY LESSONS IN THE PRINCIPLES OF GRAMMAR.

A Course of Forty Oral Lessons for the First Year (New Code, Standard IV.)

BY JOHN R. TIMSON, B.A.,
Head-Master, Board Schools, Royston, Barnsley.

LESSON XVI.

GOVERNMENT.

THE commander of a band of soldiers directs or governs. He may pick out one man and tell him to do this thing, and order another one to do that.

The master directs or governs the scholar. The scholar is governed by the master.

The work done by the commander or the master may be called *government*.

If I tear a piece of paper, and then ask you to assert what I did, you would say, "You tore the paper." It would not be true to say I tore the coat, or the collar, or anything else. The action of tearing passed to its own special object, "paper."

Tom touches some one. The action of touching passes to a particular object. Tom touches *Harry*. The word "Harry" names the object touched. It would not be true to say, "Tom touches James," if James is a long way off. The action of touching, then, passes to its own object, and the word "touches" requires the word "Harry" to name its object. In this way "touches" may be said to pick out or *govern* "Harry," as the name of its object.

Tom touches Harry.

"Touches" governs "Harry."

"Harry" is governed by "touches."

Prepositions, or position-words, require the name of a particular object.

Tom sits *before* John. "Before" requires the name "John," and thus picks out or *governs* the word "John."

The picture is *on* what? The answer is, "On the wall." "On" governs the noun "wall"—that is, it requires "wall" as the name of the object the picture is on.

The name of the object is said to be in the *objective case*—that is, it is used to name the object.

Tom throws a stone.

"Throws" governs "stone."

"Stone" is objective case, governed by "throws."

The action of throwing is done to a particular object, the stone itself. The verb "throws" governs the noun "stone," which names the end of the action.

He sits near me.

"Near" is a preposition governing the pronoun "me."

"Me" is a pronoun in the objective case, governed by "near."

The only two classes of words which require or govern the names of objects are:—

1. Transitive verbs, and
2. Prepositions.

Some pronouns always indicate an object, and must never be used for a subject. They are—me, thee, him, her, us, them.

I saw *him*.

I.....Nominative case, naming the subject.
Saw.....Transitive verb, governing "him."
Him....Objective case, governed by "saw."

He sat between her and me.

Between...Preposition, governing "her" and "me."
Her.....Pronoun, objective case, governed by "between."
Me.....Pronoun, objective case, governed by "between."

We see that "between" refers to two objects, and therefore governs or requires two names in the objective case. Never say, "Between you and I," for "I" is always nominative case. In speaking of others always put yourself last.

Remember "I, thou, he, she, we, they" are always nominative case, and "me, thee, him, us, them" are always objective case.

A man who says, "He saw she," "I told they," betrays gross ignorance of his language.

A Staffordshire boy who says, "Her came to see we," proclaims his need of education.

MEMORY NOTES.

A preposition requires the name of some object to follow it, in order to mark position in time or place.

The preposition is said to *govern* the name in the objective case.

He sat on the chair.

On.....Preposition, governing "chair."
Chair.....Objective case, governed by "on."

A transitive verb requires the name of an object to follow it, in order to mark the end of the action.

She touched me.

Me.....Objective case, governed by "touched."

Prepositions and transitive verbs govern nouns or pronouns.

The pronouns of the objective case are—me, thee, him, her, us, them.

"You" and "it" may be used for either the subject or the object.

LESSON XVII.

POSSESSION.

We have noticed how the verb "to have" is used to assert possession; for example,—

He has sixpence.

"He" is the possessor; "has" means possesses or holds; "sixpence" is the thing possessed.

I have sixpence too.

If we put the two sixpences side by side, we may distinguish them as "*his* sixpence" and "*my* sixpence."

Thus we know the one sixpence from the other—that is, we distinguish between them by naming their owners.

As the words "his" and "my" are used to name the possessors, they are said to be in the *possessive case*, which means that the names *occur* to mark some particular thing by stating the owner.

Being possessor *depends on* a thing being possessed.

Thus we say of "his" or "my" above, "Possessive case, depending on 'sixpence.'"

The pronouns have separate forms to indicate possessive case. They are, "my, thy, his, its, our, your, their," which should be committed to memory.

My son saw their master.

My.....Possessive case, depending on "son."
Their...Possessive case, depending on "master."

The English language at one time indicated the possessive case of nouns by adding "as" or "es;" but now the "a" or "e" is omitted, and an apostrophe (') put into the place of the letters omitted, like e'er for ever, can't for cannot.

The boy's hat.

Boy's.....Possessive case, depending on "hat."

But if the word already ends in "s" or the sound of "s," then the apostrophe *often* follows alone without another "s"; for example,—

Mr. Andrews' shop.

This is not *always* observed, except in the plural—

The boys' hats.

We must be very careful to put the apostrophe *after* the plural "s;" for example,—

One girl's hat.
Two girls' hats.

Possession may also be indicated by the preposition "of."

The girl's hat, or, The hat *of* the girl.
The girls' hats, or, The hats *of* the girls.

The name of the possessor is then said to be in the objective case, governed by "of."

We have now considered all the cases or circumstances under which names or their substitutes occur. The occurrence or case of the name may be:—

1. Nominative case—used to name the subject. *He* laughs.
2. Objective case—used to name an object. I saw *him*.
3. Possessive case—used to name the possessor. He took *my* book.

The Latin word *casus* means "occurrence," "that which happens," "the condition."

Now of every name which happens to be used we must ask ourselves the questions, "Under what condition does this name occur?" "Does it name (1) the subject spoken about, or (2) the object required to mark the end of action or the object demanded by a preposition, or (3) the possessor?"

The answers to these questions will tell us the *use* of the name. Hence case may be said to be the *use* of a name to indicate subject, object, or possessor.

MEMORY NOTES.

"My, thy, his, its, our, your, their" always indicate a possessor, and are in the possessive case.

Case is the distinction between the names of the subject, the object, and the possessor.

I write words in her book.

I.....Nominative case to "write."
Words....Objective case, governed by "write."
In.....Preposition, governing "book."
Her.....Possessive case, depending on "book."
Book.....Objective case, governed by "in."

A NEW AND SIMPLE METHOD OF PROVING QUESTIONS IN ARITHMETIC.

FOR TEACHERS AND STUDENTS.

Reduction.

We now come to what is an entirely new application of number-casting, and proceed to show how questions which involve the use of tables of money, time, measure, etc., may be proved, beginning with reduction.

Take, as an example, £43, 17s. 11d. reduced to pence, of which the answer is 10535 pence.

In casting out the elevens from £43, 17s. 11d., there is first a remainder, from £43, of £10. This brought to shillings is equal to 200, to which we add the other 17 shillings; this becomes 217, which, after eleven-casting, leaves a N.C. rem. 8—that is, 8 shillings. Eight shillings is 96 pence, and this treated in the same way leaves a final N.C. rem. of **8**. We do not take the 11 pence into account, as it is the number 11 itself, and thus will make no difference to the N.C. remainder. Of course, it should be specially noticed, where 11 occurs as in this instance, that it has been included in the pence in working the question, since the method of proof by eleven-casting would not show whether this had been done or not.

Turning now to find the N.C. rem. from 10535 pence in the example, we take as usual 3 from 11, and add 8 thus obtained to 5, 5, 1 (= 19), from which therefore the N.C. rem. is **8** also—the same as that obtained formerly from £43, 17s. 11d., which shows that the sum of money has been correctly reduced.

Before giving an example in another table, it may be shown how to apply eleven-casting to quantities, such as £43, 17s. 11d., in a way which will often be easier and quicker than the above. The N.C. rem. from 43 is 10, which was multiplied by 20, and 17 added to the result; but by eleven-casting with the numbers 20 and 17, we have N.C. rems. of 9 and 6 respectively, which are used thus—

$10 \times 9 = 90$, of which the N.C. rem. is 2;
then $2 + 6 = 8$—that is, 8 shillings.

Eight has now to be multiplied by 12, but instead we multiply by 1, its N.C. rem., and

$8 \times 1 = \mathbf{8}$, the final N.C. rem. as before.

In the same way as 9 is used for 20, and 1 for 12 in money tables, as multipliers, so N.C. rems. are used as multipliers in the other tables—6 for 28 lbs., 1 for 12 inches, 7 for 40 poles, etc. Even when $5\frac{1}{2}$ yards (which equal 1 pole), $30\frac{1}{4}$ sq. yds. (which equal 1 sq. pole), and $2\frac{1}{4}$ inches (which make 1 nail) have to be employed, their N.C. rems. are used instead. These are 0 for $5\frac{1}{2}$ poles (since $5\frac{1}{2} = 5{\cdot}5$, a multiple of 11), 0 for $30\frac{1}{4}$ (30·25), and 5 for $2\frac{1}{4}$. These three numbers should be kept in mind.

Take as an example of this:—

6 fur. 23 poles 4 yds. 2 ft. 9 in., which is equal to 52251 inches. Now,

6 fur. × 7 (for 40) = 42, which gives a N.C. rem. 9.
9 + 1 (for 23) = 10 poles over.
10 × 0 (for $5\frac{1}{2}$) = 0; so that the 4 yds. alone are over.
4 × 3 = 12, of which the N.C. rem. is 1; and 1 + 2 = 3 ft.
3 × 1 (for 12 inches) = 3, to which 9 inches has to be added; this makes 12, and the final N.C. rem. from it is **1**.

Again, from 52251 inches there is a N.C. rem. of **1** also.

Further consideration of questions where $5\frac{1}{2}$ yds. and $30\frac{1}{4}$ yds. occur as multipliers will be taken up again under decimal fractions, and more fully commented upon.

Compound Addition.

Example:—

£37	18	$8\frac{1}{2}$
152	15	$10\frac{1}{4}$
6	3	$1\frac{3}{4}$
0	17	9
£197	15	$5\frac{1}{2}$

In applying eleven-casting to this example, take first the simple addition of the pounds. Using the device as shown under simple addition, we have—

5 + 3 = 8; 11 − 8 = 3; 3 + 6 + 2 + 7 + 1 = 19; and the N.C. rem. of 19 is 8—that is, £8 over.

8 × 9 (or × 20) gives a N.C. rem. of 6 shillings to be carried to their column. In it

1 + 1 + 1 = 3; 11 − 3 = 8; 8 + 6 (carried) + 7 + 3 + 5 + 8 = 37, which gives a N.C. rem. of 4 shillings over.

4 × 1 (for 12) = 4, which is the N.C. rem. to be carried to the pence. With the pence it is easily seen that we may subtract 1 (contained in 10) from 4 (carried) + 9 + 1 + 8—that is, 22 − 1, which gives 10 as a N.C. rem. in pence. Ten pence equals 40 farthings, to which we add 6 farthings from that column. Forty-six thus obtained yields a final N.C. rem. of **2** farthings.

If the elevens be cast out also from £197, 15s. $5\frac{1}{2}$d., the final N.C. rem. is the same—**2** farthings—so that the sum is correct.

Compound Subtraction.

Questions in compound subtraction may easily be tested as shown in simple subtraction, or they may be treated as questions in compound addition, so that it is not necessary to exemplify the mode of application.

Compound Multiplication.

Example:—

17 cwt. 3 qrs. 9 lbs. 4 oz. × 83
= 74 tons 0 cwt. 0 qrs. 11 lbs. 12 oz.

If the elevens are cast out of 17 cwt. 3 qrs., etc., there is a N.C. rem. of 1; the N.C. rem. from 83 is 6. Then—

1 × 6 = **6**, the final N.C. rem.

And it will be found that 74 tons 0 cwt., etc., also yields **6** as the final N.C. rem.

Compound Division.

When the divisor is an abstract number, and contained an exact number of times in the dividend, the question may be treated simply as one in compound multiplication, in which the quotient, *multiplied* by the divisor, is equal to the dividend. To exemplify this, it is only needful to consider the example given in compound multiplication, which under division appears thus:—

74 tons 0 cwt. 0 qrs. 11 lbs. 12 oz. ÷ 83
= 17 cwt. 3 qrs. 9 lbs. 4 oz.

As an example of *inexact division*, we may take £878, 2s. 3d. ÷ 23, which gives a quotient of £38, 3s. 6d. and a remainder of 21 pence. This may be arranged thus:—

£38, 3s. 6d. × 23 = £878, 2s. 3d. − 21d.;

so that it may easily be treated as under multiplication. Applying the test to this question, the N.C. rems. from £38, 3s. 6d. and 23 are respectively 10 and 1. These *multiplied* give 10, and the final N.C. rem. is **10.**

Again, from £878, 2s. 3d. and 21d. (the remainder) there are N.C. rems. of 9 and 10 respectively. As 10 cannot be *subtracted* from 9, 11 is borrowed; then

(9 + 11) − 10 = **10**,

which becomes the final N.C. remainder.

From the above it will be evident that the test may be employed when one concrete quantity has to be divided by another concrete quantity of the same kind, since £878, 2s. 3d., divided by £38, 3s. 6d., gives a quotient of 23, with a remainder as shown of 21d.

Questions in which it has to be found "*what fraction one quantity is of another*" may be conveniently introduced at

this stage. If the resulting fraction be combined with the data, there are two multiplications, of which the products are equal, and therefore the N.C. rems., after eleven-casting, must be equal.

Example :—

What fraction is 27 lbs. 12 oz. 15 drs. of 3 cwt. 3 qrs. 21 lbs.? The question being worked out, it is found that

$$\frac{\text{27 lbs. 12 oz. 15 drs.}}{\text{(3 cwt. 3 qrs. 21 lbs.)} \times 16 \times 16} = \frac{113}{1792},$$

which, in applying the test, must be considered and treated as if arranged thus :—

$$\text{(27 lbs. 12 oz. 15 drs.)} \times 1792 = \text{(3 cwt. 3 qrs. 21 lbs.)} \times 16 \times 16 \times 113.$$

Now, 27 lbs. 12 oz. 15 drs. and 1792, after casting out the elevens, give N.C. rems. of 2 and 10, and the final N.C. rem. from 2×10 or 20 is **9**.

Also, the N.C. rems. from 3 cwt. 3 qrs. 21 lbs. and 16, 16, and 113 are 1, 5, 5, 3 ; further, $1 \times 5 \times 5 \times 3$ yields a final N.C. rem. of **9** also.

From what has been said, it appears that, instead of re-arranging the question, the N.C. rems., after being obtained from the question as at first exhibited, may be multiplied crosswise, thus—

$$\frac{2}{1 \times 5 \times 5} \times \frac{3}{10},$$

and then the elevens cast out of the products (20 and 75), the final N.C. rem. in each case being 9.

Other examples which involve fractions are given further on, under practice.

Vulgar Fractions.

Although this method of proof cannot be applied with advantage to all questions in vulgar fractions, on account of the number of diverse operations usually incident to such questions, it may be usefully applied to some parts, especially where the numbers are large.

In addition to the kind of fractional questions already illustrated, the test may be used to prove the numerator of a fraction where a *mixed number* has been converted into an *improper fraction*.

Example :—

$$281\tfrac{1319}{3125} \text{ becomes } \frac{879641}{3125}.$$

The new numerator is obtained from

$$(281 \times 3125) + 1516,$$

from which we get N.C. rems. $(6 \times 1) + 9$ or 15, and a final N.C. rem. of **4**.

Also, from 879641 the N.C. rem. is **4**.

The test may be similarly applied to the reverse process, when an improper fraction is converted into a mixed number.

When a fraction has been *reduced to its lowest terms*, the answer may be proved by combining it with the original fraction, and multiplying *crosswise*, as—

$$\frac{39312}{57456} \text{ which equals } \frac{13}{19}.$$

Casting out the elevens, the N.C. rems. are—

$$\frac{9}{3} \times \frac{2}{8},$$

which, multip'ied crosswise, give the same N.C. rem. of **6** for each of the two products.

Examples of the following kind require a particular method, since 11 itself is a factor of the numbers forming the fraction.

$$\frac{4235}{7315} = \frac{11}{19}.$$

When this occurs, the fraction should be reduced by its factor 11, which is best done at the beginning, thus—

$$\frac{4235}{7315} = \frac{385}{665} = \frac{11}{19}.$$

From this the N.C. rems. in the last two fractions are—

$$\frac{0}{5} \times \frac{0}{8},$$

which would give a N.C. rem. of **0** in each case.

In such instances, however, a full proof can be obtained only by removing the factor 11 *entirely* and then applying the test. When this is done, the fractions become—

$$\frac{35}{665} \text{ and } \frac{1}{19}.$$

With these the N.C. rems. are—

$$\frac{2}{5} \times \frac{1}{8},$$

from the products of which (2×8 and 1×5) the N.C. rem. is **5** in each case, and the result has then been fully proved.

In a similar manner the *continued product* of fractions may be tested. Take as an example, to find the continued product of

$$12\tfrac{17}{15} \times 8\tfrac{13}{13} \times \frac{51}{143} \times 6\tfrac{14}{15} \times \frac{14}{17} \times 2\tfrac{1}{7}.$$

The answer is $498\frac{10}{11}$.

Here the factor 11 has first to be removed from $\frac{51}{143}$ and $498\frac{10}{11}$. These become $\frac{51}{13}$ and $\frac{5488}{1}$. With N.C. rems. we have from the question

$$\frac{3}{8} \times \frac{1}{4} \times \frac{7}{2} \times \frac{5}{4} \times \frac{3}{6} \times \frac{4}{7},$$

and from the answer we get $\frac{10}{1}$.

Combine the N.C. rems. of these two expressions, and multiply them crosswise, thus—

$$\frac{6}{5} \times \frac{10}{1},$$

and the remainder is **6** in each case (from 6 and from 50).

THE INSPECTOR'S NOTEBOOK.

BY AN INSPECTOR OF SCHOOLS.

THE CLASS SUBJECTS: GEOGRAPHY.

The Map. CONTINUING the subject we began last month, let us proceed with the consideration of the lower standard course in geography. Here let me emphasise the necessity for giving thought to the preparation of the lessons. If the teaching is to be intelligent, the teacher must first of all thoroughly digest the matter, and thoughtfully arrange it, before presenting it to the class. The plan leads up to the map. First of all, the map of the district should be taken, and its connection with the plan of the school established. You then proceed to a map of the county, the country, and the British Isles. The more maps you can familiarise the children with the better. This remark applies to all standards. Now, strangely enough, there are certain features of a map which are generally overlooked by teachers. I refer principally to the scale of miles, and the lines of latitude and longitude. Of course you will not teach the meanings of *latitude* and *longitude*, *equator*, and such terms, without using a globe and any other apparatus you may have. The upper standard children often know nothing about the lines of latitude. The scale of miles I should introduce in Standards I. and II. Let the children come out in turn and measure the distances between familiar places on the map by means of a compass and reference to the scale. This will not seem strange if they have previously measured the length and breadth of their schoolroom on the plan.

* * * * * *

Standard II. Course. The course for Standard II. is generally regarded by teachers as more interesting than that for Standard I. Although there are three distinct parts to this scheme, yet more stress is, for some reason or other, laid upon the second section—geographical terms explained and illustrated by reference to the map of England. More attention should be given to the other portions.

Every school should possess a good globe, and this should be in constant use in Standard II. The earth is round like a ball. Pains must be taken to demonstrate the difference between the term *round* as applied to a ring and as applied to a sphere. Proofs of the earth's rotundity should follow, and the meanings of such words as *circumference* and *diameter* be dealt with. The relation the diameter of a sphere bears to the circumference can be actually shown. Coming to the teaching of the geographical terms, I lay great stress on the use of many maps. Naturally you begin with the district in which the school is situated. The nature of the country around the school should be referred to as illustration. I have known children living in a valley who were able to give an accurate definition of one, but who, at the same time, were unaware of the fact that they daily actually saw one. If there are rivers, streams, hills, plains, or valleys near, train the children to observe them. If you are surrounded by bricks and mortar, get your sand-tray and model some of these things. Make use, too, of the models which can now be bought to show the relief. Having taught what you can—

1. By placing the child in direct contact with the hill, the valley, etc.;
2. By allowing the child to model some of these with sand and clay;
3. By using models—

take to the maps.

The Code specially names the map of England. I should not confine myself to this map, but should make large use of the map of the world, and of all relief maps there are in the school. Avoid using the old-fashioned maps crammed with names; choose rather such maps as show the physical features only. Forget not the many excellent photographic pictures which can be easily procured nowadays.

* * * * * *

Hints for the Standard III. Teacher. I have touched upon some of the pitfalls in the Standard I. and II. schemes. We will now deal in like manner with the work set for the other standards. Standard III. geography is usually pretty well known. It is more interesting than the previous courses. Yet there are a few points which, as an examiner, I think worth troubling you with. Let your scholars realise the position of our country. Too often only the one map is used. Why not show England—

1. On the map of the world;
2. On the map of Europe;
3. On the map of the British Isles?

The intelligent teacher will not deal only with the interior of the country. By using only one map a false notion of the size of England is often obtained. Without going into details, correct ideas of the relative size of the country can be got from the maps named above. The importance of this wider teaching will become very evident when the Standard IV. course is taken up. There is no occasion, or, shall I say, there *ought* to be no occasion, in these enlightened days, to decry the method of learning by rote the names of the capes, bays, etc.

Festina lente must be your motto. Still introduce any photographic pictures you can lay hands on. Begin the year with plenty of general lessons upon the position of the country, its relative size, the physical features, etc. Take imaginary journeys round the coast and across the country, but avoid details always. Train the child to teach himself, as far as he can, by observing maps and pictures. Tell him as little as possible. Let me illustrate. Your first lessons may be entitled, "What we can learn for ourselves from the map." You need not tell the children that the east and centre are flat. Good maps placed before them will do that for you. In the same way, they will infer that Lancashire is a populous county, and that Lincolnshire is not. Let the scholars reason for themselves. The manufacturing centres can be picked out by the children. They will remember them much better by so doing than they would if a list were written on the blackboard to be learned. Ask them how the map helps them to decide that Lincolnshire is a farming county, and that South Staffordshire is a manufacturing part. Finally, do not attempt to deal in detail with the counties. A good map of the county in which the school is situated, and a thorough knowledge of the local geography, are, of course, imperative.

* * * * * *

Teach Principles and avoid Details. Continue the same kind of broad and intelligent teaching in Standard IV. Go for principles, and work the facts in with these when you can. The main thing in Standard IV., it seems to me, is to give a thorough grounding in the principles which will have to be applied in the upper standards. Do not teach in compartments, but by comparison. Place maps of Ireland and Canada side by side, and get at the resemblances and differences. The teacher well up in schoolcraft knows what to teach and what not to teach. Therein lies the secret of success.

Answers to Correspondents.

T.G.—I take it you will be unable to try again if you fail in December; but your success in 1898 will remain good.

W.—A teacher who has failed twice at the Queen's Scholarship Examination is at liberty to try any of the examinations named under Article 79 (*c*) of the Scotch Code.

Perplexed.—It is clear from the circular you refer to that the hours must be the same for the whole school. I advise you, however, to state the case to the inspector of your district.

Alpha.—Your nature-knowledge course seems to me to be largely an elementary course in practical physics. Get Gordon's *Practical Science*, Part I. (Macmillan), which will help you very much. Consult also the scheme set out on page 24 of the English Evening School Code. In history, confine your attention to a general and brief outline from the Conquest to the present time. In geography and English, you should set down what you propose to take in the coming year, and submit it (in duplicate) for approval to H.M. Inspector.

M.T.S.—Yes, you can get your certificate in the way you name. To become an inspector you must have the parchment.

Correspondence should be addressed "Inspector, care of the Editor, 33 Paternoster Row, London." In cases of urgency, an addressed envelope and two stamps should be sent.

CLASS LESSONS IN DOMESTIC ECONOMY.

BY ETHEL R. LUSH,

Author of "Chats with Children on Domestic Economy," etc.; late Organising Mistress to the Ipswich School Board, and Head-Mistress of the Ipswich Higher-Grade Girls' School.

Standard V.

Lesson XXVI.

THE SKIN AND PERSONAL CLEANLINESS: DANGER OF DIRT.

IT is my purpose in this lesson to show you what are the dangers of allowing dirt to remain on the surface of the skin; and with this object in view, we had the preliminary lesson on the structure of the skin.

Dirt and disease are closely associated. It is in the crowded and filthy slums of our large towns that epidemics rage most fiercely, and frequently have their origin; certain diseases, such as typhus fever, are actually caused by dirt; and in all cases the presence of dirt greatly aggravates disease.

Dirt is dangerous to health in many ways. You have heard that the uppermost scales of the epidermis are being constantly cast off, and their place taken by others from beneath. Some portion of the dead matter thus produced is removed at night along with the clothing; but a not inconsiderable amount remains on the skin, and if not regularly and frequently washed away, attracts to itself other waste matter, which accumulates on the surface, forming a decaying mass, and in due course this gives off the offensive smell which characterises all dirty persons.

Then, too, there is the sebaceous oil which is sent out from the sebaceous glands, and the perspiration from the sweat or sudoriparous glands. These mix with the dead scales and dirt, and form a highly disagreeable mixture, which, you

must remember, is increasing in bulk hour by hour. Think how great a quantity must accumulate in one day, and you will see how necessary is the daily bath if we are to keep our bodies sweet and clean.

But more about baths later on; for the present we are concerned with the danger of dirt to health.

If this ever-increasing mass of waste matter be left on the skin, it stops up the pores, and prevents the excretion of waste matters from the blood. How great a danger this is to health is proved by the fact that the complete obstruction of the pores is always followed by death; it is easy to understand, therefore, that partial obstruction will at least tend to produce ill-health. The reason for this is easy to see. If the pores are stopped up, the perspiration cannot escape, and the sweat glands cease to act; the blood coming to be rid of certain of its impurities finds the glands out of working order, and must, perforce, continue its course in a non-purified condition. The lungs and kidneys come to the rescue, take extra excretory work upon themselves that the blood may be kept in a normal condition, and being thus overworked, are liable to get out of order too. In this way the whole system becomes deranged, and what we call the balance of health is destroyed.

This is the most serious menace that a dirty skin has to offer, but there are various minor evils which invariably attack those who neglect nature's great law of cleanliness.

Thus it is well to note that the nemesis of a muddy, unwholesome complexion overtakes the dirty; that unsightly pimples form on the skin; that the blocking of the oil glands brings "blackheads." Personal pride alone, one would think, would ensure the daily "tub."

I have heard of people who, while ready enough to be clean in hot weather, neglect the morning bath in winter. They either ignore or are ignorant of the fact that *a dirty skin is colder than a clean one.* This is a fact which may very easily be explained. Have you noticed that in damp weather the contents of the salt-cellar are apt to become moist and clogged? This is because common salt has as one of its properties that of absorbing moisture from the air; and since common salt is one of the constituents of perspiration, the accumulation of waste matter on the skin, by attracting and absorbing moisture from the air, tends to produce a cold, clammy sensation.

Further, *a dirty skin is less sensitive than a clean one.* When you put on gloves, you diminish your sense of touch; and if the gloves are only thick enough, the sense of touch is almost neutralised. Dirt acts much in the same way, lessening the sensibility of the skin by giving it an extra covering. On first thoughts this does not appear to be dangerous to health; but if we look into the question, we find that the nerves of the skin govern the blood-vessels: when the weather is cold, they cause them to contract, thus diminishing the loss of heat from the skin; and when the weather is warm, the nerves allow an increased rush of blood to the skin, to be cooled. In this way the temperature of the body is regulated and health maintained; but if the nerves are deadened by a layer of dirt, they act less efficiently, and the system is laid open to the dangers of chill.

A very powerful incentive to cleanliness is found in the fact that dirty people are specially liable to skin diseases, especially of a parasitic nature. In the latter the skin is infested with noxious insects, which in some cases burrow into the skin, lay their eggs there, and rapidly multiply, setting up intense irritation, and sometimes causing disgusting sores.

All this is quite enough to convince you of the danger of dirt and the beauty of cleanliness. Let us see how personal cleanliness may best be ensured.

Take a bowl of water and attempt to wash your hands in it without the aid of soap: it is almost impossible to get them clean; the water stands in drops on the surface of the skin, just as it does on a greasy plate. It is owing to the greasy nature of the dirt on the skin that we find it necessary to use soap, which combines with the oily mixture and makes it possible for water to remove it.

By means of one or two simple experiments we may learn how soap is made, and why it has this property of combining with fat.

Here is a dirty oil-bottle with drops of oil still clinging to its sides. Try to cleanse it by filling it with warm water and shaking it well: it is to no purpose; the grease remains on the sides of the bottle. Now add a few small pieces of ordinary washing-soda, and shake the bottle again: the soda acts like magic in combining with the grease and leaving the bottle bright and clear. We learn from this that soda readily unites with fat.

A second experiment will show you what part soda plays in the manufacture of soap.

Half fill a large test-tube with oil, and add to it a strong solution of soda. Shake the tube well, so as thoroughly to mix the contents. In a short time you will notice that changes are taking place within the tube: the soda is acting on the oil by splitting it up into two parts—fatty acids and glycerine. The soda unites with the fatty acids to form a substance which rises to the surface, and may be recognised to be soap by rubbing it between the fingers. If we wish to harden it we must boil it.

You may make soap for yourselves at home by boiling the broken pieces of a tallow candle in a pan with caustic-soda and a little water.

Soap, therefore, acts as a cleanser in this way: the soda (or other alkali) which forms one of its constituents unites with the oil on the surface of the skin; water, which we invariably use with soap, washes the dirty mixture away; and the friction of rubbing the skin dry with a towel completes the process.

In a lesson on personal cleanliness we must not overlook the importance of baths. Broadly speaking, we may classify them as (1) hot baths; (2) cold baths. Each kind has its own particular use, and both are necessary for perfect cleanliness.

A hot bath is used to remove from the skin its accumulation of dirt and waste matter, because hot water is a more powerful solvent than cold. But the heat of the water causes the blood-vessels of the skin to dilate, allowing an increased rush of blood to the surface, and a consequent diminution of temperature. This brings about a liability to catch cold; and to avoid this, a hot bath should only be taken the last thing at night, just before going to bed. Hot baths, if indulged in too frequently, tend to lower the general tone; it is, therefore, inadvisable to take one more often than once a week.

The cold bath, on the other hand, may and should be taken daily, the first thing in the morning. If properly used, a cold bath is a valuable tonic to the system. The effect of the cold water is to contract the blood-vessels of the skin, thus sending an increased rush of blood inwards. In a state of health the reaction sets in almost at once; the general circulation is quickened, blood returns to the surface, and a delightful "glow" is experienced.

The daily cold bath also ensures that the whole body is kept in a state of perfect cleanliness, and by bracing the skin it enables one to resist the action of cold. It must be remembered, however, that some persons are too delicate to stand the shock of the cold bath: where the bather is left feeling chilly and numb instead of warm and glowing, it is wise to discontinue the practice.

Perfect cleanliness of person requires careful attention to the hair, teeth, and nails.

The hair should be brushed night and morning with a good brush, the bristles of which are long enough to reach the scalp. This practice frees the head from the dust and scurf which have accumulated during the day. From time to time the head must be washed, but not too frequently, or the hair will become dry and brittle. The use of much soap or soda should be avoided, and the hair should be carefully and quickly dried. No person with any self-respect will tolerate the presence of parasites in the hair. Clean habits will quickly get rid of the trouble.

The teeth should be well brushed night and morning and after every meal. Neglected teeth are both unsightly and unhealthy; for neglect leads to decay, and bad teeth cause indigestion.

The nails are too often neglected by careless persons. They should be kept fairly short, and never be allowed to retain the black dirt which is apt to collect at the tips.

Black-rimmed nails stamp their owner at once as a person of careless habits. Dirty nails have even been known to spread infectious diseases, by carrying the germs or microbes from one place to another.

All this points to the fact that cleanliness is a duty we owe both to ourselves and our neighbour.

SUMMARY.

Dirt is dangerous to health in many ways.

If allowed to remain on the skin, (*a*) it stops up the pores and prevents the excretion of perspiration, with the result that the blood remains impure; (*b*) blackheads and pimples are produced; (*c*) skin diseases, especially of a parasitic nature, are favoured; (*d*) the sensibility of the skin is dulled; (*e*) there is a greater tendency to take cold.

The use of soap is necessary, because water alone cannot remove the greasy accumulation on the skin.

Soap is made by boiling fats or oils with an alkali such as soda. The alkali splits up the fats, and unites with the fatty acids to form soap.

Hot baths should be taken once a week.

Cold baths should be taken daily. The former are specially cleansing, the latter bracing.

The hair, teeth, and nails must be kept scrupulously clean.

OUR ILLUSTRATED GEOGRAPHICAL NOTEBOOK.

THE GEOGRAPHICAL CONGRESS.

THE seventh International Geographical Congress was opened at Berlin on 28th September by Prince Albrecht of Prussia, Regent of Brunswick. On the ministerial tribune of the Prussian Chamber of Deputies, in which the ceremony took place, were Prince Hermann of Saxe-Meiningen; Prince Albert of Monaco; the German Imperial Chancellor, Prince Hohenlohe; the Under-Secretary for Foreign Affairs, Baron von Richthofen; the President of the Royal Geographical Society of London, Sir Clements Markham; and the President of the present Congress, Professor Baron von Richthofen, of Berlin University. Princess Theresa of Bavaria occupied the royal gallery, and in the diplomatic gallery, among others, was the British Ambassador, Sir Frank Lascelles.

Prince Albrecht of Prussia, speaking in the name of the Emperor, welcomed the members of the Congress to Berlin, and expressed his Majesty's best wishes for the success of its labours. The Imperial Chancellor, Prince Hohenlohe, also addressed words of welcome from the German Government. He spoke of the marked interest that Government had exhibited since the establishment of the German Empire in the subjects with which the Congress was concerned, pointing his remarks by allusions to the Greenland expedition of the Berlin Geographical Society, the German expeditions between 1870 and 1880 for the exploration of Africa, and the participation by the German Empire in the observations of the transit of Venus in 1874 and 1882, and in the international Polar exploration of 1882–83. The Plankton expedition of 1888, and the recent successful German deep-sea expedition, furnished further evidence of the German Government's interest. He was especially gratified by the energy manifested by the German imperial navy, which, following the example of the older seafaring nations, was now contributing its share to deep-sea investigation. The work of the *Gazelle* supplemented that of the *Challenger*. Prince Hohenlohe further referred to the special significance of the resumption of the work of Antarctic exploration, after an interval of sixty years, by England and Germany. In conclusion he said: "I find the significance and the value of international congresses in the agreements which are come to with regard to the common action of the nations in this, as in other questions which you have chosen as the subjects of your proceedings. The international arrangements which you make will secure for a long time to come a co-operation which will in an equal degree promote the advancement of science, and the closer union of the nations in the works of culture and civilisation."

It is impossible, within the limits of the space at our disposal, to do little more than barely outline a few of the numerous subjects discussed at the various meetings.

THE PRESIDENT'S ADDRESS.

Professor von Richthofen delivered his opening address, in which he stated that "the era of purely geographical exploration was drawing to a close, since almost all the world had now been explored." There is, however, much supplementary surveying to be done, and there remains vast scope in connecting earlier work. On this matter we cannot refer to a better example than Thibet. Mr. Savage Landor's recent account of his sufferings in this little-known land aroused great public interest, which was accentuated perhaps by the criticisms of Captain Henry Strachey, who was familiar with some portions of the route traversed by Landor.

OCEANOGRAPHY.

There is no doubt the Germans have taken a very noble initiative with regard to oceanography. Professor Chun of Leipzig read a paper on the German *Valdivia* deep-sea expedition. He perhaps originally proposed the equipment of an expedition, and eventually the German Parliament voted £15,000 for the purpose, and also promised grants towards publishing the results.

The *Valdivia* (2,600 tons) was a steamer of the Hamburg-American line, which was chartered and fitted up like the *Challenger*, with a staff of eleven scientific men, under the leadership of Professor Chun. The Government insured the lives and guaranteed the salaries of these men of science.

The expedition sailed from Hamburg in August 1898, first proceeding to Granton, that an inspection might be made of the collection deposited at the *Challenger* office in Edinburgh. Rounding the north of Scotland, the *Valdivia* proceeded to the Canary Islands, then along the west coast of Africa to the Cape. After examining the Agulhas Bank, it proceeded south to the Antarctic Seas, then explored the depths of the Indian Ocean, and finally returned *viâ* the Red Sea, arriving at Hamburg in April last.

Professor Chun's experiences in the Antarctic regions are particularly interesting at this present juncture. The *Valdivia* reached Bouvet Island (lat. 54° 26′ S. and long. 3° 24′ E.), which was found to be entirely buried in glacier ice, steep and inaccessible. He was particularly surprised at the depth of the sea; many soundings exceeded 3,000 fathoms, which is much deeper than hitherto supposed.

Prince Albert of Monaco gave an account of his investigations on the east coast of Greenland, dealing chiefly with the difficulty of investigating animal life in the middle depths of the ocean. In consequence of the teeming life in those depths, its smaller denizens possessed great agility of motion, to enable them to escape from the larger creatures that preyed upon them. It was only by capturing these larger creatures, and examining the food they had swallowed, that it was possible to conduct a comprehensive inquiry. But even so, investigation was difficult owing to the remarkable rapidity of the process of digestion in most of these animals.

ANTARCTIC EXPLORATION.

It was the work of the German mathematician Gauss which plainly showed the importance of magnetic observations in the south, and led to the expeditions of D'Urville, Wilkes, and Ross; and exploration of the Antarctic regions is certainly the most important geographical work of the present time. In a discussion on the approaching German and English Antarctic expeditions, Sir Clements Markham said that these parallel enterprises would form the greatest geographical undertaking that the world had ever seen, and he confidently anticipated that the domain of human knowledge would be vastly extended by them. They would also promote good fellowship between the two nations. The hearts of all geographers rejoiced to see the countrymen of Humboldt, Ritter, and Kiepert united in this work with those of Banks, Rennel, and Murchison.

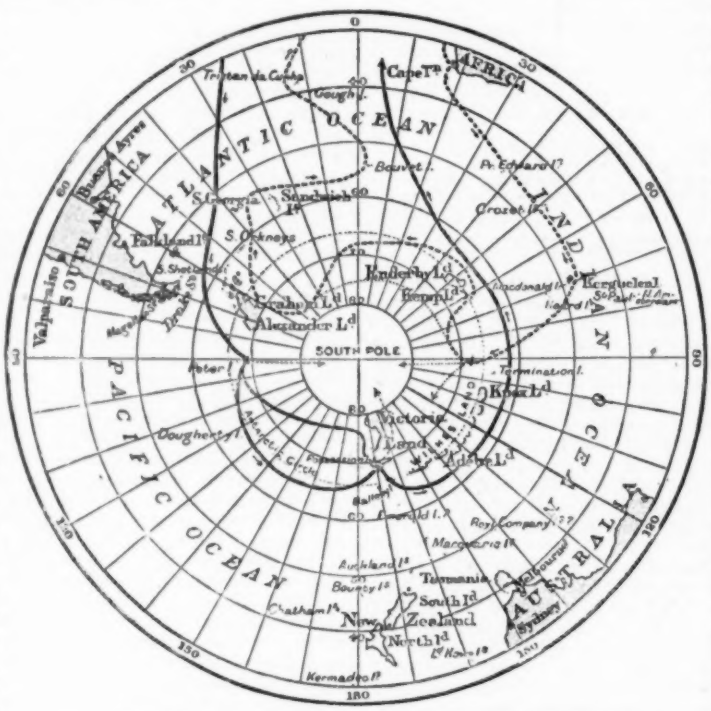
In the May number of THE PRACTICAL TEACHER we referred to the expeditions, and the accompanying map will show the proposed routes. The German expedition will be under the leadership of Dr. Erich von Drygalski, whose recent expedition to Greenland was eminently successful. He gave details of the scientific and other equipment of the German expedition next year. Dr. Nansen also spoke, and expressed strong doubts as to the existence of a great continent in the Antarctic regions.

It must be borne in mind that there are already several small and perhaps inadequate undertakings afoot. The *Belgica* sailed from Antwerp under M. Gerlache. It should have returned to Melbourne in April 1898, but was forced to winter in the Antarctic regions. Sir George Newnes has also fitted out a Norwegian ship, manned and officered by Norwegians. The vessel was re-named the *Southern Cross*, and sailed from London, August 22, 1898, under Mr. Borchgrevink.

It seems a pity that generous-minded individuals do not take experts more into their counsels, as one large joint expedition is far more likely to achieve success than the efforts of several smaller ones.

CLIMATE AND INDUSTRY.

A paper of much practical interest was read by Professor von Halle, who dealt with "the distribution of industries according to climatic zones." While admitting that Munich would probably continue to brew the best beer, and that England might always reign supreme in certain branches of the textile industry, he arrived at the conclusion that M. Reuleux's maxim, "industry belongs to the temperate zone," was fast becoming obsolete. The cold zones, as well as the tropics, were rapidly becoming the homes of manufactures. Migration of labour, moreover, was becoming international in the widest sense, and Poles, Italians, and Chinese were finding employment far from the countries of their birth.



British Route ——— German Route ..... Stations +

SUGGESTED ROUTES OF GERMAN AND BRITISH ANTARCTIC EXPEDITIONS.
(*From the "Geographical Journal," April 1899. By kind permission of Dr. J. Scott Keltie.*)

This leads to the contemplation of the problem of tropical colonisation, which is of pressing importance. In the temperate zone there is no room for any great increase in immigration, and the popular mind turns to the Great Tropical Belt, which remains a veritable Promised Land, if only Europeans could survive the climate. It is not the heat but the malaria that is the chief cause of trouble; but there is now a more than remote possibility that in the germ theory of disease lies the solution of the difficulty. It has already been conclusively proved that mosquitoes can infect persons with malarial fever, and further investigations will be awaited with interest.

THE ADMINISTRATION OF COLONIES.

Mr. Poultney Bigelow treated his subject more from a political than from a geographical point of view, and dwelt at considerable length upon the growth of the British Colonial Empire. The experience gained by England in her attempts to administer her North American colonies, and to govern her Dutch subjects in South Africa, was particularly noticed by the lecturer. The spread of the English language over North America was contrasted with the decay of the French and Spanish languages in the United States. Mr. Bigelow alluded to "the American experiment with Cuba and the Philippines," which he described as "likely to be costly on account of inexperience and conceit." After giving a rapid sketch of a visit to Kiao-chau, he went on to compare the development of the German settlement with that of Wei-hai-wei. He found that the progress of the English settlement had been much the more rapid and satisfactory, in spite of the longer time the Germans had been at work and the official efforts which had been made to develop Kiao-chau. The military and official elements were, according to the lecturer, much too predominant in German settlements. He supported this contention by referring to the prosperity of Hong-Kong, and to the harmony which prevailed there between the military and the merchant classes. In the club at Hong-Kong, for example, an officer was often proposed for membership by a civilian; in a German colony that would be inconceivable.

Other papers dealt with "the geographical distribution of the tea-plant," and "the barrage of the Nile above Assuan, and its economic importance." Dr. Scott Keltie discussed "the desirability of taking measures for obtaining a more accurate knowledge of the population of countries, especially in Africa and Asia, where no organised census exists;" and Dr. T. G. Snelson of Sierra Leone read a paper on "modern Bundooism and kindred institutions in pagan Africa."

During one of the sittings Dr. Scott Keltie received a telegram from Mr. H. J. Mackinder, the Reader in Geography at Oxford, who has just succeeded in reaching the summit of the hitherto unscaled Mount Kenia (about 18,000 feet), in British East Africa. Mr. Mackinder left England in June last in command of an expedition subsidised by the Royal Geographical Society. The telegram, which was sent *viâ* Mombasa, states that some fifteen glaciers were found upon the mountain.

At the concluding meeting on the 4th of October, St. Petersburg, Washington, and Budapest were mentioned as capitals where the next meeting of the Congress might take place, the probabilities being in favour of the first-named place.

Approval was expressed of a contemplated expedition to attempt to discover traces of the Leichardt expedition of 1848. Ludwig Leichardt was born at Trebatsch, near Frankfort-on-Oder, in 1813, and went to Australia in 1841. He conducted an expedition from Moreton Bay to the Gulf of Carpentaria in 1843. In December 1847 he started to cross the continent from east to west, and was last heard of April 3, 1848.

OUR TUTORIAL SECTION

LONDON MATRICULATION.

JUNE 1900.

BY R. C. B. KERIN, B.A. (LOND.),
First in First Class Classical Honours at Final; Principal, Carlyon College, 55 and 56 Chancery Lane, W.C.

LATIN COURSE FOR NOVEMBER.

1. Cæsar, Book IV., chaps. xxxii.–xxxvii.
2. Grammar.—The numerals and pronouns in the accidence; in the syntax, the accusative and dative cases. Note the definition of a transitive verb.
3. *Anglice Reddenda*, Nos. 21–30.
4. Sentences to be worked from Bradley's *Arnold* or Bayfield's or Allen's *Exercise Book*.

Notes on Grammar.

The numerals—cardinal, ordinal, distributive, and adverbial—are most important. Note that distributives are used (*a*) to denote "so much a piece;" (*b*) with nouns that have no singular, or that have a different meaning in the singular, as *bina castra*, "two camps;" (*duo castra*, "two forts;") (*c*) in multiplication, as *bis dena sunt viginti*, "twice ten are twenty." Be able to give a list of the numerals that are (*a*) declinable, (*b*) indeclinable, (*c*) sometimes declinable and sometimes indeclinable, like *mille*. Note that *unus* is used in the plural with words plural in form but singular in meaning, as *una castra*, "one camp." Distinguish *triceni*, "thirty a piece," and *treceni*, "three hundred a piece."

Note that *quis* is an interrogative pronoun; *qui*, an interrogative adjective or relative pronoun; *quid*, interrogative pronoun; *quod*, interrogative adjective.

It is very important to know the classes of verbs that govern the *dative*, as English equivalents of most of these verbs are transitive. Note as well that if the verb in the active does not govern the accusative case, it is used impersonally in the passive; hence *parco tibi*, "I spare you," becomes in the passive *tibi parcitur*, not *parcor*.

Among the verbs governing the dative the following are most important, and students should be able to construct sentences showing their construction:—*consulo, impero, invideo, credo, minor, adimo, resisto, pareo, parco, subvenio, aemulor, placeo, expedit, licet, persuadeo, auxilior, indulgeo, faveo, nubo, noceo, adversor, irascor, studeo, maledico, medeor, obedio, confido, libet, contingit, accidit.* Some of these verbs also govern the accusative. For example, *impero* requires the accusative of the thing requisitioned—*obsides impero civitati*, "I order the state to supply hostages" (literally, "I order hostages to the state"). *Consulo*, meaning (*a*) "to consult a person," governs the accusative; (*b*) "to consult a person's interests," takes the dative. *Invideo* takes the accusative of the thing grudged, the dative of the person envied, or to whom a thing is grudged—for example, *invideo tibi*, "I envy you;" *hoc tibi invideo*, "I grudge you this." *Credo* governs an accusative of the thing, and dative of the person; *minor* has the same construction—for example, *mortem militibus minatur*, "he threatens the soldiers with death" (literally, "he threatens death to the soldiers"). *Adimo* governs the accusative of the thing taken away, and the dative of the person from whom the thing is taken—for example, *hoc tibi adimo*. The verbs *iubeo, laedo, delecto, sino*, etc., which, contrary to the general rule, govern the accusative, are important.

Contrast *nos iubet hoc dicere* and *nobis imperat ut hoc dicamus*, "he orders us to say this." Be able to give a definition and example of the following terms:—ethical dative, predicative dative, adjectival dative, double dative (that is, the dative of the person and the predicative dative in combination), dative of advantage or disadvantage (*dativus commodi* and *incommodi*), cognate accusative, accusative of space and time, adverbial accusative, accusative of respect. Note that the dative of the agent is used with the gerundive. Learn the classes of verbs that can have two accusatives depending on them, and note what becomes of these two accusatives in the passive. The verbs of asking that do *not* take two accusatives should be known—for example, *peto, postulo, quaero*, etc.: *hoc a te peto*, "I ask you for this." Note how "ago" is expressed by *abhinc* and accusative, as *decem annos abhinc*, "ten years ago." Learn a list of the prepositions that govern the accusative. Note the rule for expressing "motion to," which we have already given in solving sentences.

Typical Sentences.

7. "Cæsar could have told your father to injure those men."
Caesar patri tuo ut his noceret dicere potuit.

Notes.—(*a*) Whenever "to" and the infinitive in English express a purpose, the infinitive must *not* be used in Latin *prose*. One of the commonest ways of expressing the infinitive in such cases is by using *ut* (= "in order that") and the subjunctive. If the infinitive has a negative attached to it, *ne* is used instead of *ut*—for example, *te rogavi ne hoc faceres*, "I asked you not to do this." From this we deduce the following rule:—After verbs denoting "ask," "command," "persuade," "advise," "strive," and similar verbs, "to" and the infinitive are translated by *ut* and the subjunctive. (*b*) For the tense of *noceret*, see last month. The action of "injuring" is future to that of "telling," hence the imperfect subjunctive is used. (*c*) *Noceo* governs the dative. (*d*) The word "men" need not be expressed; *his* is quite sufficient.

8. "Let your friends prevent our enemies from sacrificing the interests of the Romans to their own."
Amici tui inimicos nostros prohibeant quominus se Romanis anteponant (or, *sibi Romanos posthabeant*).

Notes.—(*a*) Verbs of preventing, when followed in English by "from" and a verbal noun, are generally followed in Latin by *quominus* ("by which the less") or *ne* ("lest") with the subjunctive. *Obstare* also means "to prevent," but, unlike *prohibeo*, which is a transitive verb, governs the dative. (*b*) Beware of looking out in the English-Latin dictionary and writing down a literal translation of "sacrifice." Metaphor must be treated cautiously in Latin, and it is better for the beginner to avoid retaining the metaphor in his Latin version. Turn the metaphor into unmetaphorical English. Applying this process to this sentence, we get as a result, "to prefer the Romans to themselves;" "to prefer," in this sense, is *antepono*. *Posthabeo* could also be used = "hold second to." Literally, the version in brackets will be, "hold the Romans second to themselves." (*c*) The present subjunctive is used because the action of sacrificing is future to that of preventing. (*d*) "Let" is expressed by the present subjunctive. If there were a negative, the negative would be *ne*.

9. "There are some who do not doubt that so good a man as Cicero ought to have gone to his father in Rome."
Sunt qui non dubitent quin Cicero vir optimus Romam ad patrem ire debuerit.

Notes.—(*a*) "There are some who" is expressed by *sunt qui* and the subjunctive. The subjunctive is due to the fact that when *qui* has an indefinite antecedent expressed or understood, the subjunctive is required. (*b*) After negative or virtually negative verbs of doubting, *quin* with the subjunctive is used to express "that." A rough rule for the general use of *quin* is this: whenever "but that" can be used in English, then *quin* can be employed in Latin. (*c*) Many students will translate "so good a man as Cicero" by *tam bonus vir quam Cicero*. Now *tam.....quam* are used only when there is a comparison drawn between two people. In this sentence this is not the case, and in this and in similar instances the superlative is used. Note also that *optimus Cicero* would not be good Latin; adjectives are not used with proper names unless the words *vir, femina*, etc., are also employed. (*d*) In English we use the prepositional phrase "at Rome" as an adjunct of the noun "father;" in Latin this is not done, and the Latins attached the phrase to the verb, and said "to Rome," "to his father." For the accusative, see before. (*e*) Note the tense of the infinitive *ire*. After *debeo, possum*, etc., the perfect infinitive is not used, though the English equivalents of these verbs, "ought," "could," are followed by

the perfect infinitive. The action of the "going" and the action of *debeo* are synchronous, therefore the present infinitive is used. In English, as "ought" is present and past, the past signification has to be expressed by using the perfect infinitive. This is not necessary in Latin, as *debeo* has a past tense.

Sentences.

(Readers can have their exercises corrected by sending them to the Editor Matriculation Course, *P.T.*, and enclosing seven stamps.)

1. None of the soldiers ought to have doubted that the army had been cut to pieces (*concido*).
2. After telling these men to retire to the camp at Paris (*Lutetia*), he ought not to have broken his word (*fallere fidem*).
3. How can you doubt that the general will make it his aim (*id agere ut*) to raise the siege of the town (*liberare ab obsidione*)?
4. We were with difficulty (*vix*) persuaded to make an attack on the troops that were stationed ten miles away.
5. On hearing that the soldiers had sought cover (*vitare tela*) he made up his mind (*constituo*) to march to Syracuse at once.
6. I should like him to prevent citizens as seditious as these from plotting against the king.
7. Who says that these soldiers were ordered to wheel round (*convertere signa*) and attack the enemy, who were drawn up in serried ranks (use *densa acies*)?
8. We shall advise your friends and your father's to place no confidence in the base and unscrupulous Clodius.
9. Has he persuaded the inhabitants of the town to surrender (*se dedere*) and march out under the yoke (*iugum*)?
10. How few there are (*quotus quisque*) who will dare (*audeo*) to place obstacles in his way (use *obsto*).

CAESAR—BOOK IV., XXVI. TO XXXI.

Notes.

Chap. xxvi.

notis vadis; incitatis equis—ablative absolutes—"knowing all the shallows;" "spurring on their horses."
cum animadvertisset = "noticing this." In English we often use a present participle where, strictly speaking, a past participle should be used. In Latin the present participle must not be used unless the action denoted by the participle is taking place at the same time as that of the verb to which it is attached. Here "noticing" = "having noticed." The Latins have two chief ways of translating this—(1) by *cum* and the pluperfect subjunctive, as here; (2) by ablative absolute.
iussit—iubeo, "order," requires accusative and infinitive.
conspexerat—pluperfect indicative in relative clause, denoting indefinite frequency, "whom he saw (from time to time)."
simul = *simul ac*—"as soon as."

Chap. xxvii.

imperasset—the subjunctive is due to *oratio obliqua*.
futuros—note the future infinitive, depending on the verb of promising (*polliciti sunt*).
quem praemissum (esse)—accusative and infinitive, depending on the verb of *declarandi*, *demonstraveram*. In English we should express *demonstraveram* parenthetically, "who, as I had pointed out, had been sent forward."
oratoris—genitive, depending on *modo*.
cum.....deferret—cum, with a past tense, if it can be translated by "since" or "although," requires the subjunctive.
in petenda pace—gerundival attraction. The original construction would be *in petendo pacem*, "in seeking peace." The *pacem* is changed into the same case as the gerund, and the gerundive is made to agree with it. (See Grammatical Notes.)
ut ignosceretur petierunt—"asked to be pardoned." Note that (*a*) "to" and infinitive after a verb of asking is expressed by *ut* and subjunctive; (*b*) *ignosco* governs dative in the active, therefore is used impersonally in the passive, hence *ignosceretur* is not used here.
intulissent—subjunctive in *oratio obliqua*.
imperavit—governs the accusative of the thing to be supplied. Translate here, "ordered hostages to be given," not "gave orders to the hostages." The latter would require in Latin the dative *obsidibus*.

Chap. xxviii.

post.....quam—note the separation of *post* and *quam* (*tmesis*).
appropinquarent—subjunctive, depends on *cum*.
ut nulla = "so that none;" *ne ulla* = "in order that none."
aliae.....aliae—note how to express "some" when opposed to "others."
sui—genitive, depending on *periculo* ("danger to themselves").
adversa nocte—ablative absolute.

Chap. xxix.

Eadem nocte—ablative of time "when," therefore no preposition.
accidit—"it happened"—is followed by *ut* and the subjunctive.
transportandum curaverat. The verbs *do*, *curo*, *trado*, *loco*, often require the gerundive in agreement with their object, to denote what is to be done with that object. Here *transportandum* agrees with *exercitum*, the object of *curaverat*. Translate, "took care that the army should be carried across," "provided for the transport of the army." *Ut* with subjunctive could also have been used.
neque ulla. We say in English, "and no;" the Latins prefer "nor any."
administrandi—genitive of the gerund, depending on *facultas*. The genitive of the gerund is used in dependence on (*a*) nouns in answer to the question, "what kind of?" and (*b*) certain adjectives. In form *administrandi* is the same as the genitive (masculine or neuter) of the gerundive. You can distinguish them in this way: if the form in *-di* agrees with a word, it is the gerundive; if it does not, it is the gerund. The gerundive is passive in meaning, the gerund is active.
navibus fractis—ablative absolute.
quibus.....possent—the relative here denotes either purpose or result, therefore the subjunctive is used. *Quibus* is ablative of means.
ad reficiendas eas—ad with the gerund or gerundive expresses purpose. This is another instance of gerundival attraction. (See above.)
omnibus—dative, depending on *constabat*.

Chap. xxx.

factu—the supine in *u* is used after certain adjectives.
frumento—ablative of separation, depending on *prohibere*.
belli inferendi causa—gerundival attraction. *Causa* and the genitive of the gerund or gerundive express a purpose. Note that *causa* follows the gerund or gerundive.

Chap. xxxi.

ad—"to meet."
materia; aere—ablatives, governed by *utebatur*.
effecit.....ut—literally, "he brought it about that."

Test Paper—Latin.

(Readers can have their solutions corrected by sending them to the Editor Matriculation Course, *P.T.*, and enclosing seven stamps.)

1. Illustrate by examples the difference between *quis* and *qui*, *quid* and *quod*, *duo* and *bini*, *triceni* and *treceni*, *nunquam* and *nusquam*, *ille* and *iste*, *eius* and *suus*.
2. Correct or justify—
   (*a*) *In Roma manet tribus diebus.*
   (*b*) *Nos parcimur illo homine* ("We are spared by that man").
   (*c*) *Naves civibus imperantur.*
   (*d*) *Se rogavimus ut abeat* ("We asked him to go away").
   (*e*) *Bis duo est quatuor* ("Twice two is four").
   (*f*) *Nobis laeditur ab hoc gladio* ("We are injured by this sword").
   (*g*) *Nos favisse debet* ("He ought to have favoured us").
3. Explain and give examples of the following:—predicative dative, double dative, ethical dative, dativus commodi, dative of the agent.
4. What verbs govern two accusatives? What becomes of the two accusatives when the passive construction is employed? Give five examples.
5. Parse (mark the quantities of the vowels) *interfeceris*, *capiere*, *senis*, *venis* (2), *venisti*, *canis* (2), *viri* (2), *maritimis*, *pila* (3).
6. Illustrate by examples some of the ways in which the preposition "to" may be expressed in Latin.
7. What adjectives ending in *us* and *er* have the genitive in *ius* and the dative in *i*?
8. Name the adjectives declined like *acer*.
9. Illustrate the construction of the following words:—*consulo*, *invideo*, *impero*, *iubeo*, *persuadeo*, *noceo*, *ignosco*, *sino*, *peto*, *rogo*, and *celo*.

OUR PUPIL TEACHERS' AND SCHOLARSHIP COURSE.

BY ARTHUR T. FLUX,

Head-Master of the Belvedere Pupil Teachers' Centre, First on Scholarship List, Author of "Scholarship School Management."

SPRING EXAMINATION, 1900.

Eighth Month—November.

WORK TO BE PREPARED.

1. READING AND REPETITION.

CONTINUED oral practice, with great attention to emphasis, modulation, enunciation, etc.

2. ENGLISH.

Candidates.—*Marmion*, Canto vi., lines 681 to 797.
First Year.—*The Traveller*, lines 297 to 334. Twenty roots and meanings each week. Derivation of all important words in the passage set for preparation.
Second Year.—*Julius Cæsar*, Act iii., Scene 3, to Act iv., Scene 3, line 120—"and leave you so." *Notes*, see below.

3. ESSAYS.

Write one or two essays each week, selecting from the following:—Description of any Ruin; Wages—why some men receive more than others; The Habits and Mode of Life of any Wild Animal; The Coast of England; Difficulties a Pupil Teacher meets with; The Changes brought about by the Norman Conquest; Football; Your Favourite Recreation.

4. HISTORY.

Candidates.—James I. to the Restoration.
First Year.—The Wars of the Roses to 1485.
Second Year.—George I. and George II. See *Notes* below.

5. GEOGRAPHY.

Candidates.—The physical features of Scotland, climate, and productions.
First Year.—Siberia, China, Japan, and the Malay Peninsula.
Second Year.—The United States and Central America.

6. ARITHMETIC.

Candidates.—Problems in fractions and decimals.
First Year.—Percentages.
Second Year.—Square and cube root.

7. EUCLID.

First Year.—Props. 21–24, and four deductions each week.
Second Year.—Revise Props. 7–12, with eight deductions each week.

8. ALGEBRA.

First Year.—G.C.M. and L.C.M.
Second Year.—Quadratic equations.

9. MUSIC.

Work a set of questions weekly, and take regular exercise in practical work.

Notes on the Month's Work.

1. ENGLISH.

(*a*) "MARMION."

Parsing and Analysis.

Line 681. *Hence.* Adv. of Place, mod. *might see.*
687. *Not.* Neg. Adverb, mod. phrase *in the close successive rattle.*
689. *Slow.* Adj., mod. *salutation. Far between*, Comp. Adj., qual. *salutation.*
690. *Hillock.* Nom. Absolute. *Gained*, Perf. Part., qual. *hillock.*
695. *Well.* Interjection. *Less*, Adv., mod. *shall prepare.*
696. *Watchful.* Adj., qual. *care.*
699. *Hard.* Adv. of Manner, mod. *go*, which is Subjunctive Mood.
700. *Amain.* Adv. of Manner, mod. *speed.*
709. Read, *He took his way to Surrey.*
710. Exclamations such as these cannot be analysed.
711. Supply, *You are.*
712. *Greeting.* Verbal Noun, Nom. to *serves.*
714. *Myself* = I myself. Unusual, and generally considered incorrect, for an Emphatic Pronoun to be used without the word it emphasises.
720. *Most.* Adv. of Degree, Superl. Degree, mod. *need.*
721. *Marmion.* Nom. to *would go.*
725. *Own.* Emphatic Pronoun. *Too*, Adv., mod. *fight.*
726. *Steward.* In app. with De Burg.
733. *Shrilling.* Imp. Part., qual. *cry. High*, Adv., mod. *shrilling.*
742. *To stay here is an unworthy office. To stay*, Gerundial Infinitive.
743. *Gilded spurs.* Worn only by knights. Compare, *To win his spurs*—to act so as to be thought worthy of knighthood.
746. *Sudden* for *suddenly.* Adv., mod. *was wreathed.*
750. *Volumed, fast, rolling.* Adjs., qual. *cloud.*
754. *Alone.* Adj., limiting *tread.*
754–6. *Tread, trumpet, hum* = Subjects of *told.*
757. *England.* Ind. Obj. Next sentence (Noun) Direct Object.
759. *Scarce.* Adv. of Degree, mod. *could hear.*
768–9. These Nouns are Nominatives to *were* (767).
771. *Nought.* Indef. Pronoun.
777. *Sea-mew.* Nom. to *flies* understood.
781. Read, *Like foam floats. Like* = Adv. Conj.
783. *Wide.* Adv., mod. *raged.*
785. Read, *Like rain falls.*
787. *Wild, disorderly.* Adjs., qual. *crests.*

(*b*) "THE TRAVELLER."

General Paraphrase (continued).

Line 297. The position of Holland, lying, as it does, below the level of the sea, compels the inhabitants to work hard and continuously to preserve it from destruction, and thus the habit of industry is inculcated in each, and is followed by a love of money.

And thus we find in Holland all the good and evil results which arise from an excess of wealth. Among the better features may be mentioned a comfort and luxury in their homes, good taste, and a keen appreciation of what is beautiful in art.

On the other hand, the desire for wealth induces fraud and deceit in business transactions, and so keen is this desire that the poorer classes may be said to sell their liberty for it, and the people to be divided into the rich tyrants and the pauper slaves. All higher feelings seem to be subjugated to this love of money-making, which so stunts the growth of individualism and energy that the general character of the people is as dull and stagnant as their shallow meres. They form a striking contrast to the Belgæ of old, who, if poor and uncivilised, were bold, warlike, and lovers of freedom; and still more so to the English.

Line 317. Let us now turn our attention to Britain, with its mild and genial climate. Nature seems to have lavished upon it all her choicest gifts. Its fields are brighter and fairer than those of Arcadia, and its streams more beautiful than the famed Hydaspes. The gentlest breezes sweep over it, and its woods are filled with melodious songsters.

The only striking extremes are found in the people themselves. They are men of common-sense, ambitious in laying their plans, and bold in the execution of them. Their very mien is indicative of their independent spirit, and they may fairly be considered the finest specimens of the human race. They have not been ground down by centuries of tyranny; they take a lively interest in what constitutes their rights, and insist upon them with determination. Even the poorest of the people are proud of their position, claim to criticise all matters relating to their government, and possess a self-respect unknown in other countries.

Analysis and Parsing.

Line 297. *Thus.* Adv., mod. *reign. Around*, Adv., mod. *impels.*
301. Principal Sent. *Hence all the good, with all those ills, are here displayed.*
Adjectival to *good* = that springs from opulence.
Adjectival to *ills* = superfluous treasure brings which.
305. *View.* This may either be considered as imperative or read, *If you view.*
306. *Even.* Adj. of Emphasis, lim. *liberty.*
Itself. Pronoun Emphatic, in apposition with *liberty.*
309. Supply, *It is.*
312. *Dull.* Adj., qual. *wretches.* Read, *As their lakes are dull.*
313. *How.* Adv. of Degree, mod. *unlike.*
Unlike. Adj., qual. *they*, and governing *sires* in the Objective Case.
315. *War, freedom.* Nominatives Absolute.
320. *Than.* Compar. Conj. Read, *Than famed Hydaspes is bright.*
321. *All.* Adv. of Degree, mod. *around.*
324. *Only.* Adv. of Degree, mod. the phrase *in the master's mind.*
327. *Pride, defiance.* Nominatives Absolute.
328. *Pass*—that is, *to pass.* An Infinitive, gov. by *see.*
329. *Band.* Collective Noun, in apposition with *lords.*
330–3. These lines refer to *band.*
333. *Even.* Adj. of Emphasis to *peasant.*
To scan these rights. Direct Object of *boasts.*
334. *To venerate himself.* Direct Object of *learns.*
Read, *As being a man. As*, Conjunction. *Man*, Nominative after *being.*

(*c*) "JULIUS CÆSAR," *Act iii., Scene 3.*

Line 17. *As to say they are fools.* Adv. Phrase of Degree to *much.*
18. *You'll bear me a bang.* This is a case of the Ethical Dative. Compare, *Saddle me the ass.*
It is difficult to analyse or parse the words of a disjointed conversation such as this. If it is attempted, the words understood must be supplied according to individual taste.

Act iv., Scene 1.

Line 1. *These.* Demonstrative Adj. *Many*, Indef. Pronoun.
Pricked—that is, the parchment was punctured by the stylus. The Queen still *pricks* the sheriffs for each county annually.
13. *Meet to be sent on errands. Meet* = Adj., qual. *man. To be sent*, Infinitive, mod. *meet.*
14. *World.* Nominative Absolute.
15. *One of the three.* Adj. Completion of *stand.*
16. *You thought him to be so. So*, Adj., qual. *him.*
18. "Octavius, I am older and more experienced than you. We have admitted this man into our triumvirate to suit our own convenience. We can make him bear the opprobrium of our actions. He shall assist us to carry out our plans, and work according to our direction; but when that work is completed, we can turn him adrift to look after himself, as one turns out an ass after its day's work is done."

33. *His corporal motion.* *Motion*, Nom. Absolute.
36. "A man of no originality and determination; one that adopts ideas and fashions when other men have thrown them away."
40. *But as a property* = *But as you would talk of a property.*
41. *Listen.* Used transitively in this case.
45. *Us go sit in council.* Direct Object of *let.*

Scene 2.

6. "Your master, Pindarus, either by his own actions or by those of unworthy subordinates, has given me cause to wish that what has been done had not been done."
11. *Will appear such.* *Such* in a case like this is the Adjectival Completion of the Predicate *appear.*
20. "One of the signs of the decay of genuine attachment is the increase of the outward show of regard and respect. Such punctilious attention to details is quite unnecessary between real friends; it is taken for granted.
"A false friend resembles a horse which prances and neighs, and gives every promise of vigour and endurance, but which, when it is called upon to endure long and arduous exertion, fails entirely."
44. *Nothing but love.* *But*, as used here, is often taken as a Preposition followed by the Objective Case. This is a somewhat strained meaning to assign to its relation, and breaks down entirely in such instances as, "All but *he* had fled," "They all went but *I*." The difficulty arises from the contraction of an adversative sentence: thus, in these examples the original form was, "All had fled, but he had not fled;" "They all went, but I did not go." If called upon to parse the word, it would be well to point out this peculiarity.

Scene 3.

1. *That you have wronged me.* Noun Sentence, Subj. of *doth appear.*
3. *Taking.* A Transitive Gerund.
4. *Wherein.* A Relative Adverb. Compare *whereby, wherefrom, therefore*, etc.
7. "At such a critical time as this it does not do to look too closely into the justice of every trivial act: in civil war *might* often takes precedence of *right*."
9. *Yourself.* Emphatic Pronoun.
10. *To have, etc.* = for *having.* Extension of Reason.
14. *Else* = otherwise. Adv., mod. *were your last.*
15. "Punishment has not been inflicted in this case, because the fault has received the approval of Cassius."
23. *But* = only. Adv. of Deg., mod. *for supporting robbers. Supporting*, a Trans. Gerund.
26. *As.* A Relative Pronoun.
27. *Rather.* Adv., mod. *had be*, which is equivalent to *would be*, therefore Subjunctive Mood.
28. Read, *Than I would be such a Roman.*
31. Read, *Abler than you yourself are able.*
32. *To make.* Infinitive, lim. *abler.*
43. *How choleric you are.* Noun Sent., gov. by *show.*
44. *Tremble.* Infinitive, part of the Object of *make.*
47. *Though it do, etc.* Subjunctive Mood.
Forth. Adv., mod. *will use.*
65. *That I shall be sorry for.* Noun Sentence, Obj. of *may do.*
So also in next line.
72. *Had coin* for *would coin.* Subj. Mood.
73. *Than to wring. Than*, Compar. Conj. *To wring*, Infin., gov. by *had.*
79. *Covetous.* Adjectival Completion of the Predicate.
80. Adverbial Extension of *so covetous.*
85. *Greater.* Adjectival Completion of *makes.*
91. *Huge.* Adjectival Completion of *do appear.* Read, *As high Olympus is huge.*
93. *Alone.* Adv., mod. the phrase *on Cassius.*
108. "Please yourself in what you do, and if you do anything which I consider dishonourable, I will put it down, not to your usual self, but to some strange humour which at that moment is influencing you."
112. *Straight* = Adv., mod. *is cold.*
114. *But.* Adj. of Degree, lim. *mirth* and *laughter.*
117. *To hear.* Infin., lim. *enough.*
120. *From* is here unnecessary. Take the words *from henceforth* together as an Adverb.

Students must write for assistance in any difficulty not taken here. Specimens of analysis, etc., should also be occasionally forwarded.

2. History.

Candidates.—The Stuart period is one in which the great struggle between the King and Parliament for supreme power came to a head. It is very necessary, therefore, that the candidate trace very carefully the gradual growth of the Commons, and especially of the Puritans. The Stuart theories of Divine Right, Dispensing Power, etc., must be noticed. The religious discontent is shown in James the First's reign in the various plots against him. The Hampton Court Conference is important in that it led to the Authorised Version of the Bible.

Charles had more determination than his father, and the disputes brought about a crisis. Note the three Parliaments, and especially the Petition of Right. Then followed eleven years of absolute rule, with the illegal methods of raising money. Lack of money caused the assembling of the Long Parliament, and the demands made on the King being more than he could grant, both sides had recourse to arms. For the Civil War a map of England should be prepared, all places mentioned inserted, a table of battles and their results drawn up and committed to memory.

The Protectorate is remarkable for the able rule of Cromwell, and his vigorous foreign policy. The changes in the form of government between 1642 and 1660 should be carefully noticed.

When Cromwell died, there was no leader able to unite all parties, and the nation at large was tired of the strict and sober rule of the Puritans; hence the Restoration, and the character of social life under the "Merry Monarch."

First Year.—The various battles, leaders, and results should be tabulated and learned. The results of the Wars of the Roses are most important—the breakdown of the Feudal System. Life of Warwick should also be prepared.

Second Year.—George the First. Chief events:—The Whig party in power. The Riot Act. The Rebellion of '15, and consequent passing of the Septennial Act lengthening duration of Parliament from three to seven years. The South Sea Bubble, and Walpole's remedies. Affairs in Ireland. Wood's Halfpence and the Drapier Letters.

George the Second. Walpole's able administration—a period of peace and prosperity. His Excise scheme. War with Spain. Pragmatic Sanction and War of the Austrian Succession. The '45. Reform of the calendar. The Seven Years' War. Affairs in India: Clive at Plassey, Eyre Coote at Wandewash. Affairs in America: Capture of Quebec.

Note the disasters of the early period of the war, and the great change which occurred when Pitt assumed office.

3. Geography.

Candidates.—Plenty of sketch maps; sufficient details to be inserted, and committed to memory.

First Year.—Note Russian extension of recent years in Turkestan and the Pamirs, the Trans-Siberian Railway, Russian policy in China.

China is attracting much attention amongst the European Powers at present. It is practically the only place where extension of territories can take place; it is densely populated, and therefore theoretically a good market for European produce. It seems to be breaking to pieces under the misgovernment, and each nation is anxious to "grab." The Government has been forced to yield "leases" of places to foreign nations—for example, Port Arthur to Russia, Wei-hai-wei to Great Britain. Though nominally *leased*, these possessions will never revert to China.

Japan is also important: it has risen in power more rapidly than China has declined, and is a nation and a maritime power to be reckoned with. Note that it received in 1891 a constitution based very largely upon the English.

French and English interests in the Malay Peninsula are largely antagonistic, Siam acting to some extent as a "buffer" state.

Second Year.—The United States is set for special study, and therefore much care must be taken with its preparation. Sketch maps must be drawn to illustrate every special point. Much useful and interesting information may be obtained from Geographical Readers. Do not confuse Washington the state with Washington the capital in the District of Columbia (eight miles square). The government is also important. Each state governs itself in all local matters, but they are all "federated" for national purposes—army, navy, coinage, postal system, etc. The difference between a territory and a state is that the former, not having sufficient population to govern itself, is controlled by the central government.

4. Arithmetic.

Candidates.—Any good text-book will contain a good selection of problems on fractions. The problems set in the examination require careful thought, and demand some intelligence in solution. A favourite form of question is, "If a man gives away $\frac{1}{4}$ of his money, then $\frac{2}{3}$ of the remainder, then $\frac{1}{2}$ of what then remains, and has 15s. left, what had he at first?"

These sums may be worked in two ways:—

(*a*) Let his original amount be 1.

1. If he gives away $\frac{1}{4}$, he has $\frac{3}{4}$ left.
2. He then gives away $\frac{2}{3}$ of $\frac{3}{4}$, and has $\frac{1}{3}$ of $\frac{3}{4}$ or $\frac{1}{4}$ left.
3. He then gives away $\frac{1}{2}$ of $\frac{1}{4}$, and has $\frac{1}{2}$ of $\frac{1}{4}$ or $\frac{1}{8}$ left.

$\frac{3}{8}$ of the money = 15s.
$\frac{1}{8}$ of the money = 5s.
$\frac{8}{8}$ of the money = 80s.

Or (*b*), working backwards from the result:—

1. 15s. is $\frac{3}{8}$ of the last amount, ∴ the total was 20s.
2. 20s. is $\frac{2}{3}$ of the next amount, ∴ the total was 60s.
3. 60s. is $\frac{3}{4}$ of the original amount, ∴ the total was 80s.

The last method is preferable where anything beyond fractions is introduced. For example, A woman gave away $\frac{1}{4}$ of a number of eggs *and 1*, then $\frac{1}{3}$ of the remainder, then $\frac{1}{2}$ of what then remained, and had 15 left: how many had she at first?

Reasoning backwards,—

1. She had 15 left after giving away $\frac{1}{3}$, ∴ she had 30 before.
2. 30 remained after giving away $\frac{1}{3}$, ∴ 30 = $\frac{2}{3}$ of second number, which = 45.
3. 45 is $\frac{3}{4}$ of the original number all but one.

∴ 46 is $\frac{3}{4}$ of the original number, which is **69.**

First Year.—Percentages are only particular cases of simple proportion. Remember in all cases to take cost price as 100, and calculate loss or gain *per cent.* The most *frequent* error is to omit the *per cent.* For example: A buys a horse for £100, and sells to gain 10 % to B. B sells to gain 20 % to C, and C sells to gain 25 %. It is *wrong* to say the gain is 10 + 20 + 25 = £55; for if A buys at £100, and sells at 10 *per cent.* more, he sells to B for £110. B sells for £110 + 20 per cent. of £110 = £132. C sells for £132 + 25 per cent. of £132 = £165. ∴ total gain is £65.

Another common form of question is: "A man wishes to insure a ship worth £9500 at 5 %, so that in case of loss he may recover both the value of the ship and his insurance: what must he insure for?"

In a case like this it must be remembered that every £5 paid for insurance means £100 returned. If this is to cover insurance, £95 must be reckoned as the amount insured. Therefore state

$$\text{Sum insured to get £95} = 100.$$

$$\text{Sum insured to get £1} = \frac{100}{95}.$$

$$\text{Sum insured to get £9500} = \frac{100 \times 9500}{95} = £10{,}000.$$

This is evidently correct, for on £10,000 he would pay £500 interest, and if the ship were lost he gets £9500 (value of the ship) and £500 (amount paid for interest).

5. Algebra.

The G.C.M. and L.C.M. must be worked by *factors.* In finding the factors of such an expression as $x^3 + 8x^2 + 13x + 6$, it is useful to notice that it must be produced by *three* terms multiplied by *two*, and that the two-term expression must be $x \pm 1$, $x \pm 6$, $x \pm 3$, $x \pm 2$. These can be tested. But since the sum of the coefficients in odd place = sum of coefficients in even places, it is divisible by $x + 1$. (If the numbers came the same, but different signs, it would be divisible by $x - 1$.)

$$x^3 + 8x^2 + 13x + 6 = (x + 1)(x^2 + 7x + 6)$$
$$= (x + 1)(x + 6)(x + 1).$$

6. Teaching.

All pupil teachers should take regular practice in writing on the blackboard, as prescribed in the syllabus. (Use the *Practical Teacher Copy Book* as a model.)

Test Questions.

1. Penmanship.
   Large Hand:—*Undenominational.*
   Small Hand:—*We are such stuff as dreams are made of.*

English.

2. *Candidates.*—Analyse and parse words underlined:—

"'Stint in thy prate,' *quoth* Blount; '*thou'dst best*,
And listen to our lord's behest.'
And *not* a *moment* will he *bide*
Till squire or groom before him *ride*."

First Year.—Paraphrase lines 255–266, *The Traveller.*
Analyse lines 277–280.
Parse:—"Till, seeming blest, they grow to what they seem."
Second Year.—Paraphrase (*Julius Cæsar*):—

"Good friends, sweet friends.....
.....to rise and mutiny."

Analyse:—"I am no orator.....
.....which you yourselves do know."
Parse:—"And none so poor to do him reverence."

3. *Candidates.*
   (*a*) Say what you can of the plots against Henry the Seventh.
   (*b*) What do you know of the Reformation in England?
   (*c*) Write a life of Mary Queen of Scots.

First Year.
   (*a*) What revolts were there in Henry the Fourth's reign?
   (*b*) Give an account of Henry the Fifth's campaign in France.
   (*c*) How do you account for the loss of the French provinces in Henry the Sixth's reign?

Second Year.
   (*a*) What was William's foreign policy?
   (*b*) Give the causes and results of the War of the Spanish Succession.
   (*c*) Say what you can of the social life in the time of Queen Anne.

4. *Candidates.*
   (*a*) Give an account of the physical features of Wales.
   (*b*) What do you know of Cardiff, Penryn, Lake Bala, Welshpool, Llandaff, and Anglesey?

First Year.
   (*a*) Describe the mountain system of Asia.
   (*b*) Give an account of the chief vegetable productions of (1) Siberia, (2) India.

Second Year.
   (*a*) Describe a journey by the Canadian Pacific Railway.
   (*b*) What do you understand by the term "Dominion of Canada"? How is Canada governed?

AUTUMN EXAMINATION, 1900

Second Month—November.

1. Reading and Recitation.

Regular oral practice must be taken in the reading. When a special book is set for preparation, something more is needed than mere repetition of words. All notes, meanings of allusions, etc., should be carefully prepared. The recitation should be learned early in the year. The amount set is very small, and students are advised to commit to memory all the striking passages in the poems.

2. English.

Candidates.—*Marmion*, Canto vi., lines 130–230.
First Year.—*The Traveller*, lines 51–98, with twenty roots and meanings per week.
Second Year.—*Julius Cæsar*, from Act i., Scene 2 ("I will do so; but look you, Cassius"), to the end of Act i.

(For full Notes on the Paraphrases, Parsing, and Analysis, see June Number of "Practical Teacher.")

Essay Writing.

Bear in mind the remarks made last month. Send up an essay occasionally for criticism.

Subjects for this month:—Money, A Steamship, Insects and their Uses, Good Manners, Children's Games, Printing.

3. History.

Candidates.—For this month prepare *The Norman Kings.*

Note carefully the changes produced by the Conquest, and obtain a clear idea of the Feudal System and its working. Henry the First's Charter, the Investiture Dispute, and the Civil War between Stephen and Matilda, must also be thoroughly prepared. Enter in notebooks and learn brief lives of Lanfranc, Anselm, Hereward, Robert of Normandy, and Flambard.

First Year.—William the First to Stephen.

Chief Points:—William the First. The completion of the Conquest. Rising in 1069. The Feudal System. Church reform. The revolts of the Barons. Domesday Book. Salisbury Decree. Effects of the Conquest.

William the Second. Flambard and his oppressions. The War in Normandy.

Henry the First. Establishment on the throne. War in Normandy. Great Charter. Investiture Dispute.

Stephen. Right to the throne. Civil War. State of England. Adulterine Castles. Treaty of Wallingford.

Notes on the Norman Conquest.

Completion of the Conquest. When the battle of Hastings was fought and won, on October 14, 1066, William had by no means conquered England. Had there been a capable leader who could have united the various factions, and who could have drawn together the fighting strength of the Saxons, William would have found the task before him wellnigh impossible. By the divided counsels, jealousies, and intrigues amongst the Saxons, the way was made comparatively easy. As soon as the news of the defeat reached London, a hastily-summoned gemote elected Edgar Atheling, a weak-minded boy, as king. The earls Edwin and Morcar withdrew their forces from London.

On October 20, William took Romney, and the following day Dover was occupied and accidentally burned, for which William paid compensation. Nine days later Canterbury was taken, and owing to the illness of William, the advance was delayed till late in the month. At the beginning of December, William was in Southwark, south of the river, and had to march to Wallingford before he effected a crossing. Doubling back to Berkhampstead in Hertfordshire, he awaited a deputation of the Atheling and archbishop, with others, who invited him to assume the crown; and on December 25 he was crowned at Westminster. Thus William assumed the crown, not as a conqueror, but as a properly-elected king—a point to be carefully noted.

1067. Returning in the spring to Normandy, William left the government to Odo, Bishop of Bayeux, and William FitzOsbern, whose oppressive rule and

harsh treatment soon created a blaze of revolt—the West Saxons uniting with the Welsh, and the North and North-west under Edwin and Morcar. In December, William returned, and by February 1068 had stamped out the rebellion in the west, and taken Exeter. During the summer and autumn the centre and north of England were for the first time reduced.

1069. In the autumn of 1069 the North was again in rebellion, animated by the expectation of assistance from the Danes. Hitherto William had treated the Saxons with consideration; but now his fury broke forth, and buying off the Danes, he harried and wasted the six northern counties till there were practically no people left. York and Chester bore the brunt of the fury. In 1070 the submission of Waltheof ended the last native rebellion. The conquest had meant the death of 100,000 Saxons.

The same year Hereward the Wake was driven from his camp of refuge at Ely, and became an outlaw in the Bruneswald. The student should read Kingsley's brilliant historical novel, *Hereward the Wake*, for further details.

As the conquest proceeded, strong castles were erected at important points, each of which was a link in the chain which bound down the native spirit.

The Settlement. The confiscations following the various risings had placed most of the estates in William's hands, and these were bestowed upon his followers, care being taken that no one baron should hold all his lands in one part. Not less difficult perhaps than the conquest of the English was William's reducing of his own barons. Ignorant, brutal, avaricious, of low birth in many cases, they looked upon themselves rather as colleagues of William than his vassals. England was to them a country to be spoiled, and it needed all William's authority and statecraft to keep them in check and make them recognise their true position. That he succeeded as well as he did is no small tribute to his ability. The Saxons were, in nearly all cases, dispossessed of land; the Feudal System was perfected—it *had* existed to some extent before, but now all land was held on a military tenure; the great earldoms were discontinued; William endeavoured to secure a just and firm government—just to all, and firm without being oppressive.

Revolts of the Barons:—

1075. Roger, Earl of Hereford, and Ralph, Earl of Norfolk, rebelled: *object*, to restore the old earldoms. Waltheof implicated, and executed.
1077. Revolt of Robert of Normandy.
1082. Odo of Bayeux, Earl of Kent, arrested for pride and oppression.

The Church. The church under the Anglo-Saxon *régime* had been a national church rather than a branch of the Roman Church. The clergy were ignorant and dissolute; the rules under which they worked were lax, and were not rigidly enforced. Under Lanfranc and William a strenuous and commendable effort was made to raise the whole of the tone and discipline of the clergy. Lanfranc was made archbishop in place of Stigand, and the Saxon bishops and abbots were replaced by foreigners of great learning. Separate ecclesiastical courts were established for the consideration of offences against clerical laws, and under the protection of a reformed church those stately cathedrals and churches, which are to be found all over the land, began to rise. Yet William was too far-sighted a politician to place the church directly under the rule of the Pope. He claimed supremacy: excommunication could only be carried out by his permission; nor were Papal letters to be obtained without his consent.

The Feudal System. This topic is dealt with in all text-books, and it is unnecessary to traverse the same ground. The student *must* get a clear idea of its working, and the various feudal incidents, upon which the revenue of the monarch to a great extent depended.

The *Salisbury Decree* (passed at a great gemote at Salisbury), by which every man was the king's man in precedence to all other claims, is very important.

The *Great Survey*, entered in the Domesday Book, was a statesmanlike means of providing for a proper incidence of taxation.

Changes produced by the Conquest:—

1. A new dynasty of kings introduced.
2. England was brought more into connection with the Continent—to its great gain.
3. The power of the church was strengthened.
4. A foreign nobility and prelacy introduced.
5. The Saxons on the whole became serfs.
6. A mixture of races ensued. The dull-witted, phlegmatic, conservative Saxon was improved by the infusion of the brighter, more highly educated, more abstemious Norman.
7. A strife of languages—Norman-French in the courts and by the nobility, Anglo-Saxon in the homes of the people. The strife continued till about 1300, when the Norman-French and Anglo-Saxon blended to form English.
8. The perfection of the Feudal System.
9. Increase of royal power.
10. The substitution of the Great Council (*Magnum Concilium*) for the Witenagemote.
11. Introduction of many new departures on land tenure, etc. (especially Forest Laws).
12. Increased learning, better architecture, improved manners and customs.

Second Year.—Charles the First.

Chief Points.—First three Parliaments. Buckingham. Petition of Right. Period of Absolute Rule, 1629–1638. Money raised by fines—for not receiving knighthood, for encroachments on forest land, for cottages built on less than four acres of land, for gentry who resided in London instead of on their estates. City of London fined £100,000 for extension beyond limits. Fines by Star Chamber. Selling patents of monopoly. Loans and Benevolences. Ship-money. Hampden's trial. Wentworth in Ireland. Laud and the Church. Attempt to introduce Prelacy into Scotland, and results. Short Parliament. Long Parliament and Civil War. This reign will require particular study, especially with regard to the constitutional questions involved.

4. Geography.

Candidates.—England: physical features—coast, rivers, mountains and hills, lakes, plains.

First Year.—France, Spain, and Portugal.

Second Year.—Finish Africa, with exception of the British possessions. Use maps freely and continually.

5. Arithmetic.

Candidates.—Compound practice.

First Year.—Application of fractions to money, weights, and measures; decimals; reduction of fractions to decimals; addition, subtraction, multiplication, and division.

(Note the question repeatedly set: Which vulgar fractions can be represented by finite decimals, and why?)

Second Year.—Compound proportion.

6. Euclid and Algebra.

First Year.—Euclid, Props. 1–4.

Algebra—Use of brackets; addition.

Second Year.—Euclid, Props. 30–34, with four deductions per week.

Algebra—L.C.M.

7. Music.

Candidates.—Standard scale of pitch. Mental effects, and their modifications.

First Year.—Bridge notes. Six and nine pulse measures.

Second Year.—The intervals of the minor scale.

8. Teaching.

All Years.—Practise the capital letters on the blackboard. Use a good copy. (See rules, etc., in *Practical Teacher's Copy Book.*)

Test Questions.

1. Penmanship.
   Large Hand:—*Alphabetically.*
   Small Hand:—*A man's a man for a' that.*
2. *Candidates.*—Analyse and parse words in italics:—

   "*Once walking* thus, at evening tide,
   It chanced a gliding sail she spied,
   And *sighing*, thought, The abbess *there*
   Perchance does to her home repair."

First Year.—Paraphrase and analyse, and parse words in italics:—

"But *me*, not destined such delights *to share*,
My prime of life in wandering spent and care,
Impelled, with steps unceasing, *to pursue*
Some fleeting *good* that mocks me with the view,
That, *like* the *circle* bounding earth and skies,
Allures from far, *yet*, as I follow, flies—
My fortune leads to traverse realms alone,
And find *no* spot of all the world my *own*."

Second Year.—Paraphrase and analyse:—

"And it is very much lamented of Brutus.....
Have wished that noble Brutus had his eyes."

And parse—*very, as, where, many, speaking, have wished.*

3. *Candidates.*—What right had Alfred to the title of Great? *Or*, Give an account of the work of Dunstan.

First Year.—What do you know of the Danish invasions? *Or*, In what way was the Norman Conquest made easy by preceding events?

Second Year.—Say what you can of the Puritans and their opposition to James the First.

4. *Candidates.*—Of what countries is South America comprised? Give the capitals of each.

First Year.—Say what you can of the various races of people in Europe.

Second Year.—Give some account of the present state of Egypt. How has the British occupation affected it?

5. Give rules which you would observe in correcting dictation exercises of children.

SCHOLARSHIP COURSE FOR DECEMBER 1899.

1. *Penmanship.*—Ten minutes' practice daily from *Practical Teacher's Copy Book.*

2. *Composition.*—Write one or two essays each week (subjects below).

3. *English Language and Literature.*
   (1.) Learn twenty roots and meanings per week.
   (2.) Revise the history of the language (*not* literature). Changes from Norman Conquest. Influence of printing. Revival of learning, etc.
   (3.) Pp. 481 to the end, Collier's *History of English Literature.*
   (4.) Analysis and parsing of Pope's *Essay on Man*, Ep. iv., lines 131–308.

4. *Arithmetic.*—Christian and Collar: Problems on clocks and motion. For revision purposes it will be well to take the miscellaneous exercises and look through fifty per week—not necessarily work them, but see that they could be done.

5. *Euclid.*—Book II., Props. 12–14, with six deductions per week.

6. *Algebra.*—Hall and Knight, chap. xxxvi. (Theory of Quadratics), and look over forty or fifty of the questions in miscellaneous exercises.
7. *Geography.*
   (1.) General revision of the Colonies.
   (2.) Revise South America.
   (3.) Practise memory maps regularly. (Use *Methodic Memory Maps*, PRACTICAL TEACHER Office.)
8. *History.*—Revision generally, giving especial attention to the reign of Elizabeth.
9. *Teaching.*—Chap. xv., *Scholarship School Management.*
10. *Domestic Economy.*—Revise Clothing.
11. *French.*—Finish *Le Trésor.*
12. *Music.*—Chap. xii., *School Music Teacher.*

Notes on the Month's Work.

Penmanship.—This subject *must* receive more careful attention than, judging by specimens submitted, it does. The commonest mistakes are irregularity of spacing, lack of parallelism in the slope, and a general want of uniformity in style. Little attention is paid to the details of the letters. These blemishes would soon be removed by a few minutes' intelligent study of a good copy.

Composition.—Subjects for practice :—
   (*a*) Imperial federation.
   (*b*) The British occupation of Egypt.
   (*c*) "There is a tide in the affairs of men, which, taken at the flood, leads on to fortune."
   (*d*) The increase of magazines, and its effect on general reading.
   (*e*) The causes which have made the Anglo-Saxon race the best colonists.
   (*f*) International athletics.

Send up an essay occasionally for criticism, and address same —"Scholarship Course," *P. T.* Office.

English.—The chief writers in this period are Charles Dickens, W. M. Thackeray, T. Carlyle, Tom Hood, the Brownings, De Quincey, Ruskin, Charles Kingsley, George Eliot, John Stuart Mill, William Morris, Lewis Morris. In addition to these, the last half-century has been particularly rich in good writers of "excellent mediocrity," to use Matthew Arnold's phrase. Special attention should be given to Dickens, Carlyle, and Ruskin—each a master of his own peculiar style. The influence which Dickens exercised in the home, Carlyle on national thought, and Ruskin on art, cannot yet be properly appreciated.

This is also a great scientific age, and abounds in able writers on every branch of science. As Elizabeth's reign was noted for the outburst of song, so will the reign of Victoria be looked upon as remarkable by succeeding generations for the enormous increase in scientific knowledge. The exponents of this are too numerous to mention.

The analysis of Pope's *Essay on Man* is evidently giving some difficulty to students. I can only repeat the advice of last month. It may be found a help to write out in prose order, filling up ellipses, any obscure passage. Students should see the notes in the Certificate Course, and write for assistance in any insuperable difficulty.

Arithmetic.—In what are called "watch and clock" sums, a diagram must be drawn. As an example of the method of solution take the following: "At what time between 3 and 4 are the hands together?"

Let N be the number of minute spaces past 3.

Then since the last hour * (3 o'clock) the long hand has moved 15 + N spaces, and the short hand N space. Their rates of travelling are as 12 : 1. Therefore we get the proportion—

As 15 + N : N :: 12 : 1,
or 15 + N = 12 N,
or 11 N = 15,
or N = $1\frac{4}{11}$;

therefore the time is 15 + $1\frac{4}{11}$, or $16\frac{4}{11}$ minutes past 3.

With regard to trains meeting and passing, the time occupied is—

$\frac{\text{sum of lengths}}{\text{sum of rates}}$ if meeting, and $\frac{\text{sum of lengths}}{\text{difference of rates}}$ if overtaking.

Students are strongly advised not to omit the careful looking through the miscellaneous exercises. If all those given can be solved, there need be no fear of the examination paper.

The theory of the arithmetic should also be revised, especially casting out nines; measure and multiples; proof of the rule for finding the G.C.M. and L.C.M.; proof of the addition, subtraction, multiplication, and division of fractions by diagram; proof of the rule for reduction of decimals to vulgar fractions; conditions under which a fraction may be expressed as finite, recurring, or mixed; the number of places to which a decimal may go before recurring; the theory of ratio and proportion. Exact definitions of all terms used should be committed to memory.

Euclid.—All students should now find the solution of deductions fairly easy. Practice will be needed in working against time, or the time allowed in the examination will be all too short.

Mensuration.—The following is a summary of the formulæ and facts necessary for the examination :—

1. *Right-angled Triangles.*

$$\text{Area} = \frac{\text{Base} \times \text{Height}}{2}.$$

Square on the hypotenuse = sum of the squares on the sides. From this either side can be found when the other two are given.

2. *Triangles.*

$$\text{Area} = \frac{\text{Base} \times \text{Height}}{2},$$

or where height is not given, area = $\sqrt{s(s-a)(s-b)(s-c)}$, where s is half the sum of the sides, and a, b, and c the three sides.

For example—Find the area of a triangle with sides 105, 116, 143.

105
116
143
2|364
182 = s

182 / 77 = $(s-a)$ — 182 / 66 = $(s-b)$ — 182 / 39 = $(s-c)$

$$\text{Area} = \sqrt{182 \times 77 \times 66 \times 39}$$
$$= \sqrt{13 \times 14 \times 11 \times 7 \times 11 \times 6 \times 13 \times 3}$$
$$= \sqrt{13^2 \times 7^2 \times 11^2 \times 6^2}$$
$$= 13 \times 7 \times 11 \times 6 = \underline{6006}. \text{ Ans.}$$

(*N.B.*—It is often possible to extract square root by factors without multiplying up and taking the square root.)

3. *Circle.*—Circumference = $2\pi r$ ($\pi = \frac{22}{7}$, r = radius).
   Area = πr^2.

For example—(*a*) Diameter = 4 ft. 8 in. Find circumference.

$$\text{Circumference} = 2\pi r$$
$$= 56 \times \tfrac{22}{7} = \underline{176 \text{ in.}} \text{ Ans.}$$

(*b*) Area of circle = 100 sq. feet. Find radius.

By formula, area = πr^2.
$\therefore$ 100 sq. ft. = $\frac{22}{7} r^2$
$= r^2 = 100 \div \frac{22}{7}$
$r = \sqrt{100 \times \frac{7}{22}} = \underline{5{\cdot}64 \text{ feet.}}$

To find area of circular ring.

Let R = radius of larger circle, and r radius of smaller circle.
Area of larger circle = πR^2, and of smaller = πr^2.
$\therefore$ the difference = area of ring = $\pi R^2 - \pi r^2$,
or $\pi (R^2 - r^2)$,
or $\pi (R + r)(R - r)$.

That is, multiply the sum of the radii by their difference, and the result by $\frac{22}{7}$.

CORRESPONDENCE: RULES.

To ensure an answer in the next issue, queries must be sent by the 15th of each month.

Name and address of sender, with coupon of current number of THE PRACTICAL TEACHER (and *nom de plume* if desired), must be enclosed.

As a rule, all replies will appear in the Correspondence Column; but any one desiring an immediate reply may obtain it by enclosing a stamped addressed envelope.

All communications and queries with regard to the PUPIL TEACHERS' AND SCHOLARSHIP COURSE should be addressed to "Mr. A. T. FLUX, The Bays, Belvedere, Kent."

ANSWERS TO CORRESPONDENTS.

Delicia.—Penmanship, 50/60. Use finer pen for small-hand.

Somerset.—Essay, 50/60.

Dolphin.—The sentence quoted is *one* simple sentence. The term "principal" is only applied to such sentences as have subordinate clauses depending on them.

Olivia.—Penmanship, 48/60. Not much style. Maps fairly good. Shade horizontally—8/10. Freehand. Shape and proportion of each good; lining-in is much too hard and wiry—17/20.

F. D.—A very thoughtful, well-expressed essay—55/60. It is a pity you do not make an attempt to improve your writing.

H. J. T. and Others.—*The Pupil Teachers' English Notebook* is now ready, price 8d.

(*Other correspondents answered by post.*)

* Distance travelled by each must always be reckoned from the last hour.

OUR CERTIFICATE COURSE FOR 1900.

BY GEORGE COLLAR, B.A., B.SC.,
Head-Master of the Stockwell Pupil Teachers' School.

TEST QUESTIONS ON THE OCTOBER WORK.

Theory of Teaching.

First Year.—1. What are the advantages of teaching subtraction by the method of "complementary addition"?

2. How must children acquire an idea of abstract number?

Second Year.—1. What are the qualities requisite in a good observer? Which lessons are particularly useful in training the observation?

2. What does Plato mean by a "harmony" or "mode"? What were the conditions of Greek social life that led Plato to lay so much stress on the necessity for musical training? Say what additional advantages are derived from music as a class subject in English schools.

Arithmetic.

1. Show that the number of digits in the period of a recurring decimal depends upon the denominator and not the numerator of the generating fraction.

2. Give a list of all the denominators which will produce pure recurring decimals with six digits in the period.

3. What can you tell, by inspection only, about the decimals that will be produced by the following fractions:—$\frac{5}{13}$, $\frac{7}{70}$, $\frac{4}{125}$, $\frac{15}{81}$, $\frac{7}{72}$, $\frac{27}{175}$, $\frac{5}{28}$?

English.

First Year.—1. Account for the introduction of words of Greek origin. By what tests can they generally be identified?

2. What is meant by the "music of the spheres"? Give quotations from other writers who refer to it.

3. Give instances from Epistle I. of words that have altered in (*a*) meaning, (*b*) pronunciation, since Pope's time.

Second Year.—1. Sketch the character of Prospero. In what respects does he suggest Shakespeare himself at the end of his career?

2. It has been said that *The Tempest* seems to be written in response to the question, "What is true liberty?" Show how the principal characters seem to seek after liberty.

Geography.

Both Years.—1. Trace the watershed of Europe from Gibraltar to the Ural Mountains.

2. Compare the principal groups of European lakes.

3. Give a short account of the chief European plains.

History.

Both Years.—1. Describe the relative positions of the chief political parties at the beginning of the reign of George the First.

2. Say what you can of the Septennial Act of 1716. Compare it with the two Triennial Acts.

3. In what respects did the policy of France towards England under George the First differ from its policy under William and Anne? What were the causes and what the results of this change?

Algebra.

Women.—1. Resolve into factors—

(1.) $x^3 - 2x^2 + x - 2$.
(2.) $a^6 - b^6$.
(3.) $6a^2 + 29ab + 35b^2$.
(4.) $16a^4 + 4a^2b^2 + b^4$.

2. Solve the equations—

(1.) $\frac{6x - 3}{7} + 4 = 2x - \frac{x}{4}$.

(2.) $\frac{2x - 3}{4x - 5} = \frac{3}{7}$.

(3.) $(x + a)(x + b) - b(a + b) = x^2 + \frac{2bc}{a}$.

Men—First Year.—1. Simplify the following:—

(1.) $\dfrac{\frac{1}{x+y} + \frac{1}{x-y}}{2 - \frac{x+y}{x-y}} \times \dfrac{1 - \frac{4y}{x+y}}{1 + \frac{x-y}{x-y}}$.

(2.) $\dfrac{a^2b^2}{(a+b)^3}\{4(a^3 + b^3 + ab) - 3(a^2 + b^2) - 2ab\}$.

2. Arrange as two factors the expression—

$(a - b)^2x^2 + 2(a^2 + b^2)xy + (a + b)^2y^2$.

Men—Second Year.—Prove by "mathematical induction" that if S_n is the sum of n terms of the series

$\frac{1}{1.2} + \frac{1}{2.3} + \frac{1}{3.4} + \ldots \frac{1}{n(n+1)}$, then $S_n = \frac{n}{n+1}$.

French.

First Year.—1. What is the origin of *-iss-* in the present participle (and tenses formed from it) of verbs of the second conjugation?

2. Give the present indicative, preterite indicative, and present subjunctive of *aller*, *dormir*, *courir*, and *se répentir*.

Second Year.—1. Translate:—(*a*) "There is no crime of which this man can be guilty;" (*b*) "There is no crime of which this man cannot be guilty;" and account for the moods you use.

2. Account for the use of the subjunctive in the following sentences:—

J'aime mieux que vous ne veniez pas. Quel que soit votre rang, soyez affable. C'est la meilleure chose que l'on puisse faire pour vous. Passant, qui que tu sois, respecte ce tombeau.

SYLLABUS AND NOTES FOR NOVEMBER.

English Composition.

Subjects for essays:—

1. The study of modern languages.
2. The advantages of colonies.
3. Economy of time.

Theory of Teaching.

First Year.—Complete the study of methods of teaching arithmetic. Consider all the good ways of teaching each rule, and weigh their respective advantages, not forgetting that of two methods of teaching a rule that are equally good in themselves, preference should be given to that one which facilitates the teaching of subsequent rules. Be prepared to give numerous illustrations of a concrete kind wherever the subject admits of them. Particular attention should be paid to graphic illustrations and proofs of the rules in vulgar fractions.

Logic.—Analysis of sentences, both logical and grammatical; observe the relation between the two. See Nesfield's *English Grammar*, Jevons's *Logic*, chap. xi. Study carefully the important subjects of Definition and Logical Division. See Cartwright's *Mental Science*, chaps. xi., xii., and Jevons's *Logic*, chap. xii.

Second Year.—*Psychology.* Memory; what the term includes—(*a*) grasp of what was presented, (*b*) retention of it, and (*c*) its recall.

(*a*) Importance of presenting things so that they may easily assimilate with what is in the mind. Methods of presenting facts so that their relations assist in their assimilation—for example, by one fact suggesting another. (*b*) Importance of proportion in relation to retention; necessity for forgetting detail, or putting minor matters into the back rank. (*c*) Laws of recall. Memory in relation to the will. "Trying to remember."

Training the memory. The legitimate use of "aids." The mechanical memory. "Cram."

Plato's "Republic" (*continued*).—Physical training is a necessity, but the first care in this matter is to render the soul good, for "a good soul by its virtue renders the body as perfect as possible." Intoxication must be avoided. The training should not lead to mere feats of strength, but to agility and elegance also.

The food should consist, as in the Homeric feasts, of roast meat, not boiled, nor of fish; and simplicity should be the chief characteristic of the fare. The need of physicians to correct bodily ills, and of magistrates to punish moral ills, is a sign of improper education in the city.

There should be no confirmed invalids in the state. A smith should keep himself in health to perform his allotted task, and a rich man to practise virtue.

Æsculapius held that a person should not be pampered up with medicines and dieting. If he could not live on his ordinary food, he was not of sufficiently sound constitution to benefit the state.

Note 1.—Æsculapius, a mythical personage, or god of medicine. Homer describes him as the "blameless physician," and says that his two sons were doctors in the Greek army which besieged Troy.

Note 2.—Patroclus, one of the leaders of the Greeks in the Trojan War. He retired from the conflict for a time, but finding the Greeks hard pressed, he resumed the lead, and was eventually slain by Hector. Eurypylus was a captain who served under him.

Note 3.—Phocylides was a didactic poet of Miletus, born 560 B.C.

Note 4.—Menelaus, king of Lacedæmon (Sparta), was husband of Helen, who was carried off by Paris, son of Priam, king of Troy; which act caused the Trojan War.

Note 5.—Pandarus, a Trojan captain, noted as an archer.

Plato objects to Pindar's description of Æsculapius as the son of Apollo if at the same time he practised the healing art for gold. The physician should endeavour to preserve those lives only which are likely to be serviceable to the state.

[The reader will note that this is impracticable, since utility admits of degrees, and it is absolutely impossible to draw the line between the useful and the useless.]

The educator must carefully proportion the amounts of gymnastics (tending in excess to rusticity or brutality) and music (tending in excess to effeminacy). The man who best can check his forces by music, and by gymnastics save himself from effeminacy, shall be deemed most fit to be president in the state. Dances, races, and wrestling matches need not be described in detail.

The *guardians* of the state must be men of mature age and sound judgment, whose interests are identical with those of the state, and whose opinions are proof against all attacks.

The parable of "Mother Country." Positions in the state are to be assigned in accordance with abilities, and not to be hereditary. Necessity for the soldiers living in common, being educated, and taught to despise temporal wealth.

Arithmetic.

We have been asked for solutions to the following theory questions set in recent issues:—

1. Prove that the square of every number not divisible by 5, is divisible by 5 when increased or diminished by 1.

(*a*) The unit's digit of a number determines the unit's digit of its square. Thus, numbers ending in 1, 2, 3, 4, 5, 6, 7, 8, 9, and 0 will produce squares ending in 1, 4, 9, 6, 5, 6, 9, 4, 1, and 0 respectively.

(*b*) Leaving out of account the fifth and last (which are squares of numbers divisible by 5), it will be seen that all other square numbers will produce multiples of 5 either by adding or subtracting 1.

2. Find two numbers whose product is 864, and whose L.C.M. is 144.

(*a*) The product of two numbers is equal to the product of the L.C.M. and G.C.M.

∴ G.C.M. of the two numbers = 864 ÷ 144 = 6.

(*b*) The L.C.M. divided by the G.C.M. gives those factors of the numbers which are not common.

∴ the factors not common are 2, 2, 2, 3.

(*c*) These must be arranged by putting all the twos in one number (otherwise we should have an extra common factor 2), and the three in the other.

Ans. 48 and 18.

3. Prove that if the denominators of two irreducible fractions are prime to each other, the sum of the fractions cannot be a whole number.

This depends upon the fact that if p is a factor of q, it cannot be a factor of $q + r$ unless it is also a factor of r.

Let $\frac{a}{b}$ and $\frac{c}{d}$ be two irreducible fractions whose denominators b and d are prime to one another. Then their sum is $\frac{a}{b} \times \frac{c}{d}$, or $\frac{ad + bc}{bd}$; and in order that this may equal a whole number, $ad + bc$ must be exactly divisible by b and by d. Since bc is divisible by b, the sum $ad + bc$ cannot be divided by b unless ad is divisible by b; but it is not, since a and d are both prime to b by the question. Similarly, $ad + bc$ is not divisible by d, and therefore $\frac{ad + bc}{bd}$ cannot be a whole number.

Prepare the metric system for next month, taking the system by itself, then in relation to the imperial system of weights and measures. The approximate values of the principal metric units in terms of imperial units must be remembered (1 metre = 39⅜ in., 1 kg. = 2⅕ lbs., 1 litre = 1¾ pts.). When more exact results are required, the values will be given. See *Notes on the Metric System* (Macmillan).

Practice, and household accounts, and invoices, should here be studied.

The good arithmetician has ample opportunity for showing his skill in practice, by selecting the shortest methods. This will generally be effected by taking the smallest number of aliquot parts possible. (See Christian and Collar, chaps. xxiv.–xxvi.)

English.

First Year.—1. Complete the study of borrowed words. Do not aim at learning off complete lists of words, but endeavour to associate the use and meaning of the word with its origin. This association will impart interest to the study, and increase its effectiveness.

2. *Essay on Man*, Epistle II.

1. *Know thyself.* This was the injunction to be seen written on the walls of the Temple of Apollo at Delphi.

5. *Sceptic.* The Sceptics were Greek philosophers who followed Pyrrhon, and refused to accept anything like dogmatic teaching. They preferred to consider and reason things out for themselves.

Stoics. A sect of Greek philosophers founded by Zeno. They take their name from *Stoa Poecila*, or "painted porch," at Athens, in which Zeno used to lecture. Their doctrines were revived, and the school of the "New Stoics" was founded, by Epictetus, a liberated slave, who bitterly attacked the Sceptics.

22. *Correct old Time.* An allusion to the reform of the calendar. Under the influence of the Roman Church, the Gregorian calendar had been in use on the Continent for some time. It was not introduced into England till 1752, eight years after Pope's death.

23. *Empyreal sphere.* According to Ptolemy's theory, the heavens consisted of five concentric spheres encompassing the earth. The outer one was of fire, hence called the "empyrean" (Gr. *en*, on; *pyr*, fire).

26. The later followers of Plato, or neo-Platonists, taught that the body was only a screen or image; the soul, or divine part, should be capable of *standing out* of this screen, and in this process of "standing out," or "ecstasy," it approached more nearly to the divine perfection. Some of the doctrines of the neo-Platonists were of Egyptian origin; hence the reference in the two following lines.

34. Observe that the similitude is not drawn between Newton and an ape, but between the *curiosity* manifested at the sight of each. Pope had such a profound admiration for Newton's genius that he wrote,—

> "Nature and Nature's laws lay hid in night;
> God said, 'Let Newton be,' and all was light."

42. See Cowper's short poem on *Human Frailty*. The second verse, if not the whole of this poem, should be committed to memory.

49–50. Cut off all those outgrowths of science (that is, of knowledge) which have formed arts out of our very vices.

56. *Govern.* Here used in its literal sense, to direct: Latin, *gubernare*, to steer (a ship).

59–80. Notice the antitheses, metaphors, and similes; and observe the repeated use of "that" for the former—that is, Self-love; and "this" for the latter—that is, Reason. Compare the use of *celui-ci* and *celui-là* in French.

81. *Subtle schoolmen.* In the Middle Ages philosophers used to lecture, chiefly on theology, in the cathedral schools or cloisters; hence they were called "schoolmen." Their teaching consisted principally in an endeavour to apply the methods of Greek philosophy to Christian doctrines. The most noted were—Abelard, Alcuin, Anselm, Lanfranc, Lombard, Scotus, Thomas Aquinas, William of Ockham, and John Buridan. As an instance of the trifles over which they wasted "the rash dexterity of wit," we may cite the case of "Buridan's ass." Buridan affirmed that if an ass were placed exactly midway between two haystacks, the poor animal would die of starvation, because he would have exactly the same attraction in each of two opposite directions.

93–177. This section deals with the passions and the purpose they serve.

101. The Stoics, however, made no boast "in lazy apathy." They merely taught that we should not be carried away by our passions, but should keep them under control. (See *Gertrude of Wyoming*, ver. 23.)

108. *The card*—that is, the compass.

132. *Aaron's serpent.* An allusion to Exod. vii. 9–12.

148. Vinegar is not produced by "Heaven's blest beam." The fermentation is the result of the action of a germ in the presence of *air*.

159. *Humours*—literally, fluids. The early physicians attributed many ailments (including tempers) to various fluids in the body. Notice the use of "*a* gout;" we now say "*the* gout."

165–168. A mightier power (than Reason) drives strongly in an assigned direction, and impels different men to their respective ends; just as one wind, among various, drives mariners, though tossed by other breezes, each in a constant direction to the coast he is seeking.

Second Year.—Finish reading *Henry VIII.* We shall shortly deal with the difficulties.

Read L. Hunt's *Essays*—Introduction and first twelve Essays—to end of the Essay "On the Realities of the Imagination."

English History.

Both Years.—Read the account of George the Second in Thackeray's *Four Georges* for the biography of the king himself.

Study in detail the home affairs of the reign of George the Second. (Foreign affairs next month.)

The following points require close attention :—

1. *Walpole's Excise Bill.* It is a fundamental principle in taxation that every tax should cause the greatest possible profit to the state, and the smallest possible inconvenience to the individual paying it. Let us take the case of the duty on a hogshead of brandy: this would amount to about £20 or £25, and that amount is all the Government would receive, no matter when the duty was paid. But as the brandy is kept frequently eight or ten years after it is landed before it is sold, it is evident that if the importer has to pay the duty at the time of landing instead of at the time of selling to his customers, he must charge some £8 or £10 more by way of interest on the duty paid; consequently the consumers, who really bear the tax, would pay on account of the tax £8 or £10 more than the Government would receive. The main provision of Walpole's Bill was that goods liable to duty might be kept in "bonded warehouses," under Government supervision, until the tax was paid, and consequently the tax need not be paid until shortly before the consumption of the goods. It also required that dealers in such goods should be licensed. This provision would have enabled the Government to trace smuggled goods, but it would also have saved the dealers from unfair competition with dealers in smuggled goods. The Bill was therefore based on sound principles, but the unreasoning cries of Walpole's opponents obliged him to withdraw it. The Porteous Riots afford a further proof of the unpopularity of Excise duties. (Read Scott's *Heart of Midlothian*.)

2. *Relations with Scotland.* Study carefully the accounts of the rising of 1745 in favour of the "Young Pretender," particularly the steps taken for the pacification of the Highlands, 1747. Note the confidence shown in the Highlanders in the Militia Bill, 1757.

3. Prepare biographies of the chief statesmen—Lord Carteret, the Duke of Newcastle and his brother Sir Henry Pelham, Pitt and Fox. We shall give special notes on Walpole next month.

Geography.

(These notes should have appeared in the September number.)

The Settlement of the European Powers in 1713.

The Treaty of Utrecht is a collection of treaties between France and the different allies, having one agreement in common :—

1. That the thrones of France and Spain should never be united.

2. That Philip should be acknowledged King of Spain and of the American possessions of the Spanish monarchy.

The European states mainly affected were England, France, Spain, Portugal, Holland, Prussia, Savoy.

[Mark on a map of Europe the territories of the different powers after the signing of the treaty.]

The kingdoms of Denmark, of Norway, and of Sweden, and the Russian and Ottoman Empires, remained as before, their boundaries being the same as in the present day, except that the Sultan of Turkey was then ruler of the northern states of the Balkan Peninsula, which have since gained their independence.

England.—By the Treaty of Utrecht England gained in Europe Gibraltar and Minorca. The following year the Elector of Hanover, who had obtained Bremen and Verden from Denmark, became King of England (George the First).

France.—France gained the principality of Orange, kept Strasbourg, but ceded some territory to the Duke of Savoy. Lorraine, which had been recovered from Germany in the tenth century by Charles the Simple, and had become a separate dukedom under Albert of Alsace (1044), did not revert to the French crown until after the death of Stanislaus Leczinsky (1766).

Spain.—By the Treaty of Utrecht Spain was stripped of half her European possessions :—

(*a*) Sicily was ceded to the Duke of Savoy ;

(*b*) Milan, Naples, Sardinia, and the Netherlands to the Emperor;

(*c*) Gibraltar and Minorca to England.

Philip the Fifth renounced all claim to the French crown. By a new treaty in 1720—

(*a*) Sardinia was given to the Duke of Savoy ;

(*b*) Sicily to the Emperor.

Portugal was separated from Spain after the Treaty of Lisbon (1688), and remained a separate kingdom.

Austria.—Austria, by the Treaty of Utrecht, gained scattered possessions ; but these did not give increase of power.

The Netherlands, Milan, Mantua, Naples were added to the empire ; Sicily was added in 1720.

By the Barrier Treaty (1715) Austria was much irritated because the Dutch secured a line of fortresses in the Austrian Netherlands.

In 1737 Naples and Sicily were ceded to Spain, and part of Milan to the King of Sardinia.

Prussia.—In the seventeenth century the Brandenburg territory was augmented by the addition of parts of Prussia ; and in 1701 the Electorate of Prussia was raised to the rank of a kingdom, the Elector of Brandenburg being the King of Prussia. By the Treaty of Utrecht, Louis the Fourteenth acknowledged the title of the King of Prussia.

Savoy.—The Duke of Savoy gained territory from France, and received the island of Sicily ; this island was surrendered to Austria in exchange for Sardinia in 1720, when Sardinia, Savoy, Piedmont were formed into the kingdom of Sardinia. By the Treaty of Rastadt (1714) the Electors of Cologne and Bavaria were reinstated.

Algebra.

Women—Both Years.—Involution. See the notes for First Year men in the August number. Master the rules there given and apply them to examples. Further practice in factors.

Men—First Year.—Revise simple equations. Pay particular attention to the three ways of solving simultaneous equations.

Men—Second Year.—Master the chapter on the binomial theorem (for positive integral indices), so as to be able to give—

(*a*) Proof of the general formula for an expansion.

(*b*) The formula for the $(r + 1)$th term.

(*c*) The coefficient of any given term.

Note that the expansions are symmetrical with respect to the coefficients—that is, the coefficients remain unchanged if the order of the terms is reversed.

Euclid.

Women—First Year.—To the end of Prop. 34. Carefully distinguish between the several propositions dealing with parallel lines. The two corollaries to 32 are important, and seem at first rather difficult, from the *general* character of the terms used ; but the use of *particular* terms is impossible, as the number of sides to the figure is not given, and our proofs must include *all* cases.

Women—Second Year.—To the end of II. 4. The second book is not very difficult, as soon as the student is familiar with the two ways of denoting a rectangle. Thus, we may speak of a given rectangle as the rectangle ABCD, referring to the actual area covered ; or as the rectangle AB . BC, referring to two adjacent sides which contain it. Most of the propositions are proved by first referring to the rectangles as areas, and showing the equality between a whole figure and the sum of its parts, and then naming those parts in terms of the lines which contain them. Prop. 4 can be proved by combining 2 and 3 ; but the method in the book, although much longer, gives us the valuable corollary, which is useful later on.

Men—First Year.—To end of III. 30, with exercises.

Men—Second Year.—To end of VI. 19. This will complete the text required. We shall then deal with riders.

Languages.

We have received the following Memorandum from the Education Department :—

Syllabus for Certificate Examination 1900.

Latin and Greek.

The Latin author for First Year candidates is Cæsar, *De Bello Gallico*, Book IV., cap. xx., to Book V., cap. xxiii. (The Invasion of Britain) ; and for Second Year candidates the selected portions are Horace, *Odes*, Book III., and Cicero, *De Officiis*, Book III., cap. i. to x., ending with *pace vel Quirini vel Romuli dixerim*.

The Greek author for First Year men is Euripides, *Hecuba* : and for Second Year men the selected portions are Sophocles, *Antigone* (omitting all the choruses), and Plato, *Ion*.

Latin.

First Year.—Principal parts of verbs of the fourth conjugation. Follow The Practical Teacher Matriculation Course in Latin author and composition.

Second Year.—Syntax of the dative and ablative cases. Horace, *Odes*, Book III., 1–4.

French.

First Year.—Irregular verbs of the third conjugation. *Voyage au Centre de la Terre*, chaps. xxii.-xxviii.

Second Year.—Careful study of the rules for the agreement of the past participle. *Le Roi des Montagnes*, Practical Teacher edition, to page 53, line 11, *en moins de cinq minutes*. Exercises vii. and viii.

Answer to Correspondent.

J. P. Larkin.—No ; you cannot take any other subjects.

QUERY COLUMN.

RULES.

1. Each correspondent is restricted to *one* question.
2. Each query must be accompanied by the *coupon* which appears on the back wrapper of the current number of the Journal.
3. CORRESPONDENTS MUST IN ALL CASES STATE THE SOURCE FROM WHICH THEIR QUERY HAS BEEN OBTAINED.

The Editor reserves to himself the right to decline to answer any question which is, in his judgment, unsuited to the Magazine.

Claremont.—Please apply to Messrs. W. and A. K. Johnston, Edinburgh.

A. W. B.—(*a*) Show that for a given velocity of projection there are two elevations which will hit a given point, and that these two directions are equally inclined to the elevation which is necessary to hit the point with the least possible velocity of projection.

(*b*) A ball is projected from a point A at an inclination α to the horizontal, and in a plane perpendicular to a vertical wall, which is at a distance d from the point of projection. Show that after rebounding from the wall it will again pass through A if $V^2 \sin 2\alpha = gd\,\frac{1+e}{e}$, where V is the velocity of projection, and e the coefficient of restitution.

The first part (*a*) may be obtained from any text-book on mechanics. Briefly the steps are as follows:—

The vertical distance described by a projectile in time t is given by $Vt \sin \alpha - \frac{1}{2}gt^2$ . . . . . (1);

The horizontal distance described in the same time by $Vt \cos \alpha$ . . . . . (2);

Where V denotes the initial velocity, and α the angle which the direction of projection makes with the horizon.

If d and a are the co-ordinates of the given point, then by substituting the value of t from (2) in (1), we obtain—

$$a = d \tan \alpha - \frac{gd^2}{2V^2 \cos^2 \alpha}$$

$$= d \tan \alpha - \frac{gd^2}{2V^2}(1 + \tan^2 \alpha),$$

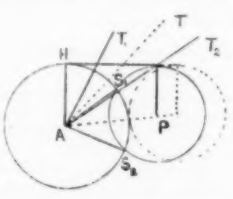
$$\text{or } \tan^2 \alpha - \frac{2V^2}{gd} \tan \alpha + 1 + \frac{2V^2 a}{gd^2} = 0.$$

Solving for α, we obtain—

$$\tan \alpha = \frac{V^2}{gd} \pm \sqrt{\left(\frac{V^4}{g^2d^2} - \frac{2V^2 a}{gd^2} - 1\right)} \quad . \quad . \quad (3).$$

From (3) it is evident that when the quantity under the radical sign is positive, there are two values for α; when it is zero, there is only one value; and when negative, no value—that is, there may be two directions of projection which will satisfy the problem: these two directions may coincide, or there is no direction in which the body could be projected with the proposed velocity so as to pass through the given point.

The result is obtainable by a simple geometrical construction. Let A be the point of projection, and P the given point. Draw AH vertical and equal to $\frac{V^2}{2g}$; then a horizontal line through H is the directrix of the parabolic path. With A and P as centres, describe circles. Let these cut at S_1 and S_2; then the two directions of projection, AT_1 and AT_2, are obtained by bisecting the angles HAS_1 and HAS_2. When



the two circles touch, S_1 and S_2 coincide, and there is one direction of projection; and if the circles do not meet, there is no possible direction.

(*b*) Using the same notation as before: as the impact on the vertical wall makes no change in the vertical velocity at the instant, the whole time of motion is $\frac{2V \sin \alpha}{g}$. This is the time in which the original vertical velocity is destroyed by gravity, and also the time in which the same vertical velocity is generated, the two times being equal.

The horizontal velocity until the ball strikes the wall is $V \cos \alpha$, and the ball to reach the wall requires a time $\frac{d}{V \cos \alpha}$.

After impact the horizontal velocity is $eV \cos \alpha$, so that the ball takes the time $\frac{d}{eV \cos \alpha}$ to return to the point of projection.

Equating the two expressions, we have—

$$\frac{2V \sin \alpha}{g} = \frac{d}{V \cos \alpha} + \frac{d}{eV \cos \alpha}.$$

$$\therefore 2V^2 \sin \alpha \cos \alpha = gd\left(1 + \frac{1}{e}\right),$$

$$\text{or } V^2 \sin 2\alpha = gd\left(1 + \frac{1}{e}\right).$$

Tim.—A cylindrical bell, 4 feet deep, whose content is 20 cubic feet, is lowered into water until its top is 14 feet below the surface of the water, and air is forced into it until it is three-fourths full. What volume would the air occupy under the atmospheric pressure, the water barometer being at 34 feet?

The pressure of the air inside the bell exceeds the atmospheric pressure by an amount due to a column of water, the height of the column being the distance from the surface of the water in the bell to the surface of the water outside. Hence the pressure on the enclosed air is that due to 17 feet of water, together with the water barometer—that is, 17 + 34 = 51 feet.

Thus the quantity of air sufficient to fill three-fourths of the bell is that quantity of air which occupies a volume of 15 cubic feet at a pressure of 51 feet of water.

From Boyle's Law it follows that the same quantity of air would, at a pressure due to 34 feet of water, occupy a volume equal to $\frac{51 \times 15}{34} = 22{\cdot}5$ cubic feet.

The same result may be obtained as follows:—

Denoting by V the volume of the enclosed air, and by V^1 the volume of air at atmospheric pressure which must be forced in to maintain the water-level, then we have—

$$(V + V^1)\,34 = V\,(17 + 34).$$

$$\therefore V^1 = \frac{V \times 17}{34} = \frac{15 \times 17}{34}$$

$$= 7{\cdot}5 \text{ cubic feet.}$$

Therefore total volume = 15 + 7·5 = 22·5 cubic feet.

——. The angle of elevation of a balloon from a station due south of it is 60°, and from another station due west of the former, and distant a mile from it, is 45°. Find the height of the balloon. (Lock's *Trigonometry*.)

Draw a perspective figure showing the positions of the stations and balloon. Call the first station M, the second N, the balloon B. Draw a vertical from B meeting the horizontal plane passing through MN in P.

MN is one mile long, MNP is a right angle, PMB is 60°, and PNB is 45°. Consider the triangle PMB, and we get—

$$\frac{PM}{PB} = \cot 60° = \frac{1}{\sqrt{3}}, \therefore PM = \frac{PB}{\sqrt{3}}.$$

Consider the triangle PNB. $\frac{PN}{PB} = \cot 45° = 1, \therefore PN = PB.$

Consider the triangle PMN. $PN^2 = PM^2 + MN^2.$

$$\therefore PB^2 = \left(\frac{PB}{\sqrt{3}}\right)^2 + (1)^2, \text{ and } PB^2 = \frac{PB^2}{3} + 1, \text{ from which } PB^2 = \frac{3}{2} = \frac{6}{4}.$$

$$\therefore PB = \frac{\sqrt{6}}{2} \text{ miles.} \quad \text{Ans.}$$

A. Lindesay.—A man took money out of a bank giving 2½ per cent., and bought five £20 shares bearing interest at 8½ per cent., the shares to be paid up in six equal instalments. He at once paid up five instalments, and at the end of a year and a half, the

property having increased 17½ per cent. in value, he sold his shares. What did he gain by the whole transaction?
(Evans' *Arithmetic.*)

This is probably the case of a newly-formed company issuing £20 shares which are to be paid up in six equal instalments, at various times, as required by the company.

If a man bought *one* share, and at once paid up *one* instalment—namely, ⅙ of £20—the company would pay him 8½ per cent. on ⅙ of £20 until the second instalment was paid. If he at once paid up the six instalments—namely, £20—he would receive 8½ per cent. on £20 from that date.

In the above example, let us assume for a moment that he at once pays up the *six* instalments. He takes £100 out of the bank, and invests it in five £20 shares paying 8½ per cent. At the end of a year and a half he receives as interest £8½ × 1½ = £12¾.

Assuming that the *value of the shares* increases at the same rate as the *value of the property*, he sells his five shares for £117½.

In the eighteen months he has therefore received £12¾ + £17½ = £30¼. But if he had allowed his £100 to remain in the bank, he would in this time have received £2½ × 1½ = £3¾ as interest. He has therefore gained £30¼ − £3¾ = £26½ by the transaction.

Now consider the actual case.

He takes ⅘ of £100 out of the bank, gets ⅘ of £12¾ interest, and gains ⅘ of £17½ simply by selling; and therefore gains ⅘ of £26½ = £22, 1s. 8d. on the whole transaction. Ans.

The buyer actually pays him ⅘ of £117½ for the *whole* five shares, but the buyer will have to pay the final instalment to the company when required, and will receive only ⅘ of £8½ per annum until the final instalment is paid up.

A.C.—A owes B £1000, due at the end of four months. However, he pays ½ of it at the end of three months, and ½ of it a month later. When ought he to settle his account?

By paying £$^{10}_{2}{}^{0}_{0}$ a month before it is due, A loses a month's interest on that sum.

He pays £$^{10}_{3}{}^{0}_{0}$ at its proper time—namely, at the end of four months.

He has still to pay $(1 - \frac{1}{4} - \frac{1}{2}) = \frac{1}{12}$ of £1000.

The interest on this from the four months' end until settling day must be equal to the one month's interest on the £$^{10}_{2}{}^{0}_{0}$.

This period must therefore be $\frac{1}{12} \div \frac{1}{2} = 1\frac{1}{4}$ months.

The final settling day is 1¼ months after the end of the four months.

X.Y.Z.—Consider the expression

$$(1 - x)^2 (ac + bd)^2 - 4 (ad - bcx) (bc - adx),$$

in which a, b, c, d, x are all real. Show that for the expression to be positive for all values of x, the necessary and sufficient condition is that $a^2 - b^2$ and $c^2 - d^2$ have the same sign.
(S. and A., May 1898.)

Multiply out the given expression, and arrange in powers of x, and we get—

$$(a^2c^2 + b^2d^2 - 2abcd)x^2 - 2(a^2c^2 + b^2d^2 + 2abcd - 2a^2d^2 - 2b^2c^2)x + a^2c^2 + b^2d^2 - 2abcd,$$

which is a quadratic expression.

Now, any quadratic expression, $Ax^2 + Bx + C$, is *positive* for all values of x, so long as (1) A is *positive*, and (2) $B^2 - 4AC$ is not greater than zero. (See any text-book on algebra.) In the given expression the coefficient of x^2 is $(ac - bd)^2$, which is always *positive*. Hence the first condition is satisfied.

The second condition is that

$$[2(a^2c^2 + b^2d^2 + 2abcd - 2a^2d^2 - 2b^2c^2)]^2 - 4(a^2c^2 + b^2d^2 - 2abcd)(a^2c^2 + b^2d^2 - 2abcd)$$

is not greater than zero, or that

$(a^2c^2 + b^2d^2 + 2abcd - 2a^2d^2 - 2b^2c^2)^2 - (a^2c^2 + b^2d^2 - 2abcd)$ is not *positive*.

This is of the form $x^2 - y^2$, and can be resolved into factors analogous to $(x - y)(x + y)$.

The factors obtained in this way reduce to

$$(-2a^2d^2 - 2b^2c^2 + 4abcd)(2a^2c^2 + 2b^2d^2 - 2a^2d^2 - 2b^2c^2),$$

or $-4(ad - bc)^2 (a^2c^2 + b^2d^2 - a^2d^2 - b^2c^2)$.

Now this expression will always be *negative* if the right-hand factor is *positive*—that is, if $a^2c^2 + b^2d^2 - a^2d^2 - b^2c^2$ is positive; that is, if $(a^2 - b^2)(c^2 - d^2)$ is positive. This will be positive if $a^2 - b^2$ and $c^2 - d^2$ have the same sign.

Chemical Geology.—You do not specify for what purpose you require the book, so we are unable to say whether or no the subject is treated sufficiently fully in an ordinary text-book to suit your purpose. We can recommend *Geology: Chemical and Physical*, by Sir Joseph Prestwich, published by the Clarendon Press at 25s., and Bischof's *Physical and Chemical Geology* (Harrison), 31s. 6d.; but perhaps Rutley's *Study of Rocks* (Longmans), 4s. 6d., would answer your purpose, if you only wish to get well acquainted with the chemical composition of the various minerals and rocks. Another book on these latter lines is Hatch's *Text-Book of Petrology* (Sonnenschein), 7s. 6d.

T. Gillett (Cardiff).—In order to prepare yourself for the Part I. Honours Examination of the Science and Art Department in Electricity and Magnetism, you will have to familiarise yourself with those points in the science which can be investigated without the use of the differential and integral calculus, etc. In addition, questions may be asked on the connection between electricity and magnetism, and heat and light. You will be required, for instance, to understand Carnot's theorem as to the efficiency of a heat engine, in connection with Lord Kelvin's investigation of the thermo-electric diagram. You can find a simple and yet sufficiently complete account of Carnot's theorem in *Heat for Advanced Students*, by E. Edser (Macmillan and Co.).

The best book on electricity and magnetism for your purpose is unquestionably J. J. Thomson's *Lessons in Electricity and Magnetism*. Some simple applications of the calculus are used in this book, but if you have followed the articles on the calculus in these columns, you should find no trouble. Your best plan would be to read J. J. Thomson's book, and write to us as to any difficulty you experience. You will find it most useful to determine where your difficulty really lies; a mere statement of a difficulty often suggests an explanation. You should also obtain the questions set in the Science and Art Examinations for Honours, Part I., in recent years, and attempt to answer these. Send those that you cannot answer to the Editor of THE PRACTICAL TEACHER, accompanied by a coupon, and, if suitable, an answer will be given in the Query Column, or a reference to a book will be given.

J. Gatehouse.—The best books are undoubtedly the following:—

Sound, Advanced—Catchpool's *Sound* (University Correspondence Series).

Light, Advanced—*Light*, Emtage (Longmans). *Light*, Stewart (U.C.C.).

Heat, Advanced—*Heat for Advanced Students*, Edser (Macmillan and Co.). *Heat*, Draper (Blackie).

Electricity and Magnetism, Advanced—*Electricity and Magnetism*, S. P. Thompson (Macmillan). *Magnetism and Electricity for Beginners*, Hadley (Macmillan). This is a very instructive book, but is not in itself sufficient to cover the advanced syllabus. Similar remarks apply to *Electricity and Magnetism for Beginners*, Sanderson (Macmillan).

Honours (Part I.) in Elementary Mathematics—Hall and Knight's *Higher Algebra*; Loney's *Trigonometry* (Parts I. and II.); Nixon's *Euclid Revised*.

Inter. B.Sc.—No. The Science and Art Department does not recognise a teacher in any subject whatever on the strength of having passed an intermediate university examination. Graduates are allowed to teach the subjects forming part of their university curriculum. Application should be made to South Kensington, when a declaration of recognition will be sent to the local secretary. Of course, the Department may exceptionally allow an unqualified man to teach, so that there will be no harm in applying; but the rule is as above.

Fertilis, J. W. Wilkinson.—Solutions by post.

Text-books.—In answer to inquiries, we recommend for Honours (Part I.) Elementary Mathematics the following:—Hall and Knight's *Higher Algebra*; Loney's *Trigonometry*, Parts I. and II.; and Nixon's *Euclid*.

For Honours Theoretical Mechanics it is a difficult matter to recommend suitable books. The following may be consulted:—For Solids, *Dynamics*, Williamson and Tarleton (Longmans); *Statics*, by Minchin. For Fluids, Greenhill's *Hydrostatics* (Macmillan), and *Hydrostatics* and *Elementary Hydrokinetics*, by Minchin (Clarendon Press).

OUR SCIENCE SECTION

☛ **Subscribers requiring Explanations of Difficulties in any branch of Science, or Advice upon Courses of Study, can obtain all help required by communicating with the Editor, and accompanying their query with the Coupon cut from this Number.**

NOTES ON ADVANCED AND HONOURS PHYSIOGRAPHY.

The Atmosphere of Planets.—Dr. G. H. Bryan made some interesting remarks as to the permanence of certain gases in the atmosphere of planets, in a paper read before the British Association at Dover. A test of the permanence or otherwise of different gases in the atmosphere of the various celestial bodies at different temperatures has been found, and a superior limit has been obtained for the rate at which any planet would lose any gas by the molecules flying off from its atmosphere. To interpret this limit in the simplest possible form, the author has calculated the number of years that would have to elapse in various cases before the quantity of gas lost would be equivalent to that contained in a layer one cm. thick covering the surface of the earth. For simplicity, absolute temperatures of 200°, 300°, 400°, 500°, and 600° have been chosen—that is, Centigrade degrees of −73°, 27°, 127°, and so forth.

Hydrogen, Helium, Water, Air.—In the case of terrestrial *hydrogen*, the loss in question would occupy 84,000,000,000 years at temperature −73°, 600,000 years at −23°, and 222 years at 27° C. For *helium* on the earth's surface, the corresponding numbers are $3{\cdot}5 \times 10^{36}$ years at −73°, 3×10^{10} (or thirty trillion years) at 27°, 84,000,000,000 years at 127°, 600,000 years at 227°, and 222 years at 327°. For vapour of *water* on Mars, the figures are $1{\cdot}2 \times 10^{32}$ years at −73°, $1{\cdot}9 \times 10^{16}$ (or nineteen thousand billion years) at 27°, 2,400,000,000 years at 127°, 43,000 years at 227°, and 106 years at 327°.

The removal of a layer of air one cm. in thickness from the surface of the earth would only mean a lowering in the average barometric pressure of $\frac{1}{13\cdot6}$ of a mm., roughly.

Suppose, then, that the aforementioned gases were present in the respective atmospheres in sufficient quantity to produce pressures comparable with our atmosphere, and assume that a fall of one mm. in the average height of the barometer is the least secular change that could be detected by a barometer:—

Conclusions.—The only possible conclusions from these results are:—

1. That helium could not exist permanently in our atmosphere at ordinary temperatures.

2. That watery vapour could exist permanently in the atmosphere of Mars at ordinary temperatures.

3. That if helium once existed in appreciable quantities in the earth's atmosphere, it must have escaped when the earth was far hotter than at present.

4. That a similar conclusion holds good on the supposition that Mars once possessed, but has now lost, vapour of water as a constituent of its atmosphere—the temperature-limit at which the loss ceased to be appreciable being, however, lower than for terrestrial helium.

5. That hydrogen, on the other hand, may escape to an appreciable extent from the earth's atmosphere at ordinary temperatures.

The Future of the Earth (Dr. Murray).—The surface of the globe has not always been as we now see it. When, in the past, the surface had a temperature of about 400° F., what is now the water of the ocean must have existed as water-vapour in the atmosphere, which would thereby—as well as because of the presence of other substances—be increased in density and volume. Life as we know it could not then exist. Again, science foresees a time when low temperatures, like those produced by Professor Dewar at the Royal Institution, will prevail over the face of the earth. The hydrosphere and atmosphere will then have disappeared within the rocky crust, or the waters of the ocean will have become solid rock, and over their surface will roll an ocean of liquid air about forty feet in depth. Life as we know it, unless it undergoes suitable secular modifications, will be extinct. Somewhere between these two indefinite points of time in the evolution of our planet it is our privilege to live.

The Six Spheres.—When we regard our globe with the mind's eye, it appears at the present time to be composed of concentric spheres, very like, and still very unlike, the successive coats of an onion. Within is situated the vast nucleus or *centrosphere;* surrounding this is what may be called the *tektosphere* (Gr. τηκτός, molten), a shell of materials in a state bordering on fusion, upon which rests and creeps the *lithosphere*. Then follow *hydrosphere* and *atmosphere*, with the included *biosphere* (βιος, life). To the interaction of these six geospheres, through energy derived from internal and external sources, may be inferred all the existing superficial phenomena of the planet.

The Heavy Centrosphere and Lighter Lithosphere.—The vast interior of the planetary mass, although not under direct observation, is known to have a mean density of 5·6, or twice that of the ordinary surface rock. The substances brought within the reach of observation in vein-stones, in lavas and hypogene rocks—by the action of water as a solvent and sublimant—warrant the belief that the centrosphere is largely made up of metals and metalloids with imprisoned gases. It is admitted that the nucleus has a very high temperature; but so enormous is the pressure of the superincumbent crust, that the melting-point of the substances in the interior is believed to be raised to a higher degree than the temperature there obtaining. The centrosphere, in consequence, remains solid. Astronomers, from a study of precession and nutation, have long been convinced that the centrosphere must be practically solid. Recent seismological observations indicate the transmission of two types of waves through the earth—the condensational-rarefactional and the purely distortional—and the study of these tremors supports the view that the centrosphere is not only solid, but possesses great uniformity of structure.

Uniformity of the Centrosphere: Heterogeneity of the Lithosphere.—The original crust of the earth was almost certainly composed of complex and stable silicates, all the silicon dioxide being in combination with bases. Lord Kelvin has pointed out that when the solid crust began to form, it would rapidly cool over its whole surface; the precipitation of water would accelerate this process, and there would soon be an approximation to present conditions. As time went on, the plastic or critical layer—the tektosphere—immediately beneath the crust would sink deeper and deeper, while ruptures and readjustments would become less frequent than in the earlier stages. With the first fall of rain the silicates of the crust would be attacked by water and carbon dioxide, which can, at low temperatures, displace silicon dioxide from its combinations. The silicates, in consequence, have been continually robbed of a part or the whole of their bases. The silica thus set free goes ultimately to form quartz veins and quartz sand on or about the emerged land, whilst the bases which were leached or lixiviated out of the disintegrating rocks are carried out into the oceans and ocean basins. A continuous disintegration and differentiation of materials of the lithosphere, accompanied by a process of migration and selection among mineral substances, is thus always in progress. Through the agency of life, carbonate of lime accumulates in one place; through the agency of winds, quartz sand is heaped up in another; through the agency of water, beds of clay, of oxides of iron and of manganese, are spread out in other directions.

Application to Ocean Basins and Continents.—From the earliest geological times the most resistant dust of the continents has been strewn along the marginal belt of the sea-floor skirting the land. The continuous loading on the margins of the emerged land by deposits tends, by increased pressure, to keep the materials of the tektosphere in a solid condition immediately beneath the loaded area. The unloading of emerged

land tends, by relief of pressure, to produce a viscous condition of the tektosphere immediately beneath the denuded surfaces. Under the influence of the continuous tremblings always taking place in the lithosphere, the materials of the tektosphere yield to the stresses acting on them, and the deep-seated portions of the terrigenous deposits are slowly carried towards, over, or underneath the emerged land. The rocks subsequently re-formed underneath continental areas out of these terrigenous materials, under great pressure and in hydrothermal conditions, would be more acid than the rocks from which they were originally derived, and it is well known that the acid silicates have a lower specific gravity than the intermediate or basic ones. By a continual repetition of this process the continental protuberances have been built up of lighter materials than the other parts of the lithosphere. The present condition of the earth's crust might be brought about by the disintegration of a quantity of quartz from volcanic rock, covering the continental areas to a depth of 18 inches, and the re-formation of rocks out of the disintegrated materials. Where the lighter and more bulky substances have accumulated there has been a relative increase of volume, and in consequence bulging has taken place at the surface over the continental areas. Where the denser materials have been laid down there has been flattening, and in consequence a depression of the abysmal regions of the ocean basins.

CHEMISTRY NOTES.

BY THOMAS CARTWRIGHT, B.A., B.SC. (LOND.),

First Class Honourman in Chemistry; Lecturer on Chemistry to the Middlesex County Council; Author of "Elementary Practical Chemistry," etc.

Atomic Weights—O = 16 as the unit.—Professor Tilden brought the question of the atomic weight standard before the British Association. He said that the practice, which has prevailed since the days of Berzelius, of expressing atomic weights in terms of hydrogen (H = 1), is now abandoned by the Committee of the German Chemical Society in favour of the new scale, in which oxygen is the standard, and O = 16. The considerations which have influenced the several members of the committee are chiefly three—namely, first, the uncertainty still supposed to attach to the ratio H : O, though this is as accurately known as it is likely to be; secondly, that the atomic weights of many elements may be deduced directly from the composition of their compounds with oxygen, but less frequently from compounds with hydrogen; thirdly, and chiefly, because the oxygen scale brings many atomic weights very near to whole numbers.

Manufacture of Nitrite of Soda.—The manufacture of this substance, which is largely used in the dyeing industry, has engaged the attention of Herr Daebon, who gives an account of the process in the *Chemiker Zeitung*. The raw material used in the manufacture is purified Chili saltpetre, which is melted in large cast-iron vessels, whereby the hygroscopic water is got rid of, and a part of the iodides and iodates always found with the $NaNO_3$ of Chili saltpetre is decomposed. The saltpetre begins to fuse at 310°, but the temperature is raised from 400° to 410° C. before the lead necessary for the decomposition is added. This lead should be pure, antimony especially being absent, as the presence of other metals may bring about the decrepitation of the whole charge; and it is employed in the form of thin sheets. Fourteen parts by weight of lead are added to five parts by weight of saltpetre, the lead being added as soon as the desired temperature has been attained—the whole being continually stirred to secure intimate mixing. To avoid the piercing of the vessel, the charge must not be allowed to become too strongly heated: cooling, if necessary, is accomplished either by adding further quantities of cold saltpetre, or by withdrawing the fire. When all the lead has been added, the stirring must be continued for some time, after which the molten mass is ladled out and run in the form of thin needles into cold-water solution, therein being assisted by constant stirring. Besides the nitrite, about 1 per cent. of caustic soda is produced, which dissolves in some of the oxide of lead that is formed, and which has now to be removed by neutralising with HNO_3, saltpetre being re-formed; and the oxide of lead is precipitated as insoluble hydroxide. There is now in solution sodium nitrite, undecomposed saltpetre, caustic soda holding oxide of lead in solution, and the soluble impurities of the saltpetre. The insoluble residue consists of oxide of lead, and a very small quantity of metallic lead which has escaped oxidation.

The solution, diluted to a specific gravity of 6° to 8° Baumé, is neutralised with nitric acid; the oxide of lead in solution is precipitated, the acid being added so long as a precipitate is formed. The neutralised solution is separated from the insoluble residue, and is concentrated in cast-iron pans until it has a strength of from 42° to 45° Baumé, when warm.

The insoluble residue is thrown on a large filter of coarse material, such as sacking washed with warm water, and the wash waters added to the principal solution. The residuary oxide of lead is capable of various applications. The concentrated solutions are added together in cast-iron vats and left to crystallise. If the crystals are impure, they must be purified by recrystallisation. The pure crystals are separated in a centifrugal machine, washed, dried, and packed. The drying takes place in an oven with a temperature of about 50°, and the crystals are packed in cylinders of double parchment paper.

It is worthy of note that sodium nitrite is not an alkaline body, as has often been stated, but is quite neutral.

Solid Hydrogen.—One of the most interesting papers read at Dover before the British Association was by Professor Dewar, describing his preparation of solid hydrogen. The apparatus employed was as follows:—A flask, of about a litre capacity, was drawn off into a tube bent twice at right angles. Into the neck of this flask was sealed a mercury manometer, and the whole having been filled with pure dry hydrogen, was sealed. The lower portion of the right-angular tube was calibrated, and this limb was immersed in liquid hydrogen contained in a tube, with a vacuum jacket arranged for exhaustion. As soon as the pressure got well below that of the atmosphere, perfectly clear liquid hydrogen began to collect in the calibrated limb of the tube. When the pressure was reduced to 30 or 40 mm., the liquid hydrogen surrounding the outside of the tube suddenly passed into a solid, white, foam-like mass, almost filling the whole space. As it was not possible to see the condition of the hydrogen in the interior of the calibrated tube, since it was surrounded by the solid, the whole apparatus was turned upside down, to see if any liquid flowed down into the flask. As there was no appearance whatever of any liquid, it was evident that the tube was also filled with solid hydrogen. By placing a strong light on the side of the vacuum test-tube opposite the eye, and maintaining the exhaustion at about 25 mm., gradually the solid became less opaque, and the material in the calibrated tube was seen to be a transparent ice in the lower part, but the surface looked frothy. This fact prevented the solid density from being determined, but the maximum fluid density has been approximately found to be ·086, the liquid at its boiling point having a density of ·07. The solid hydrogen melts when the pressure of the saturated vapour reaches about 55 mm. In order to determine the temperature, two constant volume hydrogen thermometers were used. The mean temperature of the solid was found to be 16° absolute, under a pressure of 35 mm. The melting point of hydrogen was found to be about 16° or 17° absolute. The practical limit of temperature obtained by the evaporation of solid hydrogen is from 14° to 15° absolute. The critical temperature of hydrogen is about 30° to 32° absolute, so that, as in the case of nitrogen, the melting point is about one-half the critical temperature. The foam-like appearance of the solid when produced in an ordinary vacuum is due to the small density of the liquid, and the fact that rapid ebullition is substantially taking place in the whole mass of liquid. The last doubt as to the possibility of solid hydrogen having a metallic character has been removed, and for the future hydrogen must be regarded as an unquestionable non-metallic element.

Action of Sodammonium and Potassammonium on Tellurium and Sulphur.—M. Hugot, in *Comptes Rendus*, gives the following details of these reactions:—In the presence of excess of the alkali two amorphous tellurides are formed, Na_2Te and K_2Te, both being white and insoluble in liquid ammonia. By making use of this latter property, the tellurides are separated from excess of ammonium alkali. By merely substituting sulphur for tellurium, the two monosulphides Na_2S and K_2S are formed. When tellurium is used in large excess, the tellurides Na_2Te_3 and K_2Te_3 are formed. They resemble the monotellurides in appearance. In the case of excess of sulphur being used, the bodies Na_2S_3, K_2S_3, which absorb ammonia gas, are formed.

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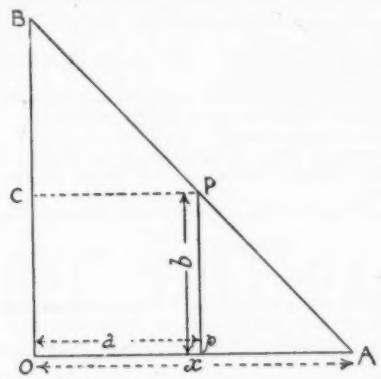
DIFFERENTIAL AND INTEGRAL CALCULUS FOR BEGINNERS.

MAXIMA AND MINIMA (continued). *Problem.*—A given point P is situated in the quadrant between the axes of x and y. It is required to draw a straight line through P, cutting the axes in the points A and B, subject to the condition that the length AB shall be as small as possible.

We will solve the above problem in two different ways, in order to exemplify the variety in the methods by which such problems may be attacked.

Since the position of the point P is given, its co-ordinates,



$Op = a$, $pP = b$, must be known. Let $OA = x$. Then, since the triangles APp, ABO are similar, we have

$$\frac{BO}{OA} = \frac{Pp}{pA}. \qquad \therefore \frac{BO}{x} = \frac{b}{x-a}. \qquad \therefore BO = \frac{bx}{x-a}.$$

Let the length of the line $AB = u$.

Then $u = \sqrt{(OA)^2 + (BO)^2} = \sqrt{x^2 + \left(\frac{bx}{x-a}\right)^2}$.

It is required to find the value of x, which will give to $u = \left(x^2 + \frac{b^2x^2}{(x-a)^2}\right)^{\frac{1}{2}}$ a minimum value.

First of all, it can easily be seen that u may acquire a minimum value. For if $OA = x$ is increased indefinitely, the line BA will become more and more nearly parallel to the axis of x, and will therefore be indefinitely increased in length. Starting with the line BA very nearly parallel to OA, it can be seen that as the angle BAO is increased, the length of BA will at first decrease. When, however, the angle BAO approximates to a right angle, the line BA will be approximately parallel to the axis OB, and will therefore again have acquired an indefinitely great length. Hence, as the point A is moved toward O from an indefinitely great distance along OA, the length of the line BA will at first decrease, and subsequently increase. Therefore there must be some position of the point A, defined by a value of x between ∞ and a, for which the line BA possesses a minimum length.

$$u = \left(x^2 + \frac{b^2x^2}{(x-a)^2}\right)^{\frac{1}{2}}.$$

$$\frac{du}{dx} = \frac{1}{2}\left(x^2 + \frac{b^2x^2}{(x-a)^2}\right)^{-\frac{1}{2}} \times \left\{2x + \frac{2b^2x(x-a)^2 - 2(x-a)b^2x^2}{(x-a)^4}\right\}$$

$$= \frac{1}{2}\left(x^2 + \frac{b^2x^2}{(x-a)^2}\right)^{-\frac{1}{2}} \times 2x\left\{\frac{(x-a)^4 + b^2(x-a)^2 - b^2x(x-a)}{(x-a)^4}\right\}.$$

$$\therefore \frac{dn}{dx} = \frac{x\,\dfrac{(x-a)^4 + b^2(x-a)^2 - b^2x(x-a)}{(x-a)^4}}{\dfrac{(x^2(x-a)^2 + b^2x^2)^{\frac{1}{2}}}{x-a}}$$

$$= x\,\frac{(x-a)^3 + b^2(x-a) - b^2x}{(x-a)^2} \Big/ (x^2(x-a)^2 + b^2x^2)^{\frac{1}{2}}.$$

For u to be a minimum, $\frac{du}{dx} = 0$.

$$\therefore x\,\frac{(x-a)^3 + b^2(x-a) - b^2x}{(x-a)^2} \Big/ (x^2(x-a)^2 + b^2x^2)^{\frac{1}{2}} = 0 \quad . \quad . \quad . \quad (1).$$

This equation now requires careful consideration. If $x = 0$, the value of the expression on the left-hand side will be reduced to zero, since it is multiplied by x. The solution so obtained does not, however, apply to the problem in hand, since, as previously explained, x varies only from ∞ to a.

We can therefore divide the equation through by x.

We can multiply the whole expression by the quantity in the denominator, namely—

$$(x^2(x-a)^2 + b^2x^2)^{\frac{1}{2}},$$

and so remove this quantity from the equation, provided we are sure that it will not become equal to zero or infinity for any value of x contemplated in the problem.

The quantity in question would become equal to ∞ if $x = \infty$—a value excluded from the problem.

The expression would become equal to zero if $x = 0$—another value excluded from the problem.

Squaring, and dividing through by x^2, we get—

$$(x-a)^2 + b^2.$$

This cannot be equal to ∞ unless $x = \infty$. For it to be equal to 0,

$$x = a \pm \sqrt{-b^2},$$

which is an impossible solution, since it involves the square root of a negative quantity.

We therefore conclude that we may multiply (1) by the quantity in the denominator.

Performing this operation, we obtain

$$\frac{(x-a)^3 + b^2(x-a) - b^2x}{(x-a)^2} = 0.$$

We may multiply this through by $(x-a)^2$, since, when $x = a$ (and the denominator consequently becomes equal to zero), the line BA will be parallel to OB, which position cannot obviously correspond to a minimum value of OA.

Finally we have—

$$(x-a)^3 + b^2(x-a) - b^2x = (x-a)^3 - b^2a = 0.$$

$$\therefore x = a + a^{\frac{1}{3}}b^{\frac{2}{3}}.$$

The value of x will make the length of the line AB a minimum. To find this minimum length, we have—

$$BA = \sqrt{x^2 + \frac{b^2x^2}{(x-a)^2}} = \frac{x\sqrt{(x-a)^2 + b^2}}{x-a}$$

$$= \frac{\left(a + a^{\frac{1}{3}}b^{\frac{2}{3}}\right)\left\{a^{\frac{2}{3}}b^{\frac{1}{3}} + b^2\right\}^{\frac{1}{2}}}{a^{\frac{1}{3}}b^{\frac{2}{3}}}.$$

Dividing the quantity between the first brackets by $a^{\frac{1}{3}}b^{\frac{2}{3}}$, and removing the quantity $b^{\frac{1}{3}}$ from the second brackets, we get for the length of BA—

$$u = \left(a^{\frac{2}{3}}b^{-\frac{2}{3}} + 1\right) \times b^{\frac{2}{3}} \times \left\{a^{\frac{2}{3}} + b^{\frac{2}{3}}\right\}^{\frac{1}{2}}$$

$$= \left(a^{\frac{2}{3}} + b^{\frac{2}{3}}\right)\left\{a^{\frac{2}{3}} + b^{\frac{2}{3}}\right\}^{\frac{1}{2}} = \left(a^{\frac{2}{3}} + b^{\frac{2}{3}}\right)^{\frac{3}{2}}.$$

As solved above, the problem in hand requires a certain amount of analytical skill to obtain the correct solution. It has been worked out in this manner in order to point out a number of considerations which are frequently useful. A much simpler solution will now be given.

Instead of taking x as an independent variable, let us take the angle $BAO = \theta$.

Then $\frac{b}{PA} = \sin\theta. \qquad \therefore PA = \frac{b}{\sin\theta}.$

Similarly, $\frac{PC}{PB} = \frac{pO}{PB} = \frac{a}{PB} = \cos\theta.$

$$\therefore PB = \frac{a}{\cos\theta}.$$

Then length $BA = u = PB + PA = \frac{a}{\cos\theta} + \frac{b}{\sin\theta}.$

$$\therefore \frac{du}{d\theta} = +\frac{a\sin\theta}{\cos^2\theta} - \frac{b\cos\theta}{\sin^2\theta}.$$

When $\frac{du}{d\theta} = 0$,

$$\frac{a\sin\theta}{\cos^2\theta} - \frac{b\cos\theta}{\sin^2\theta} = 0. \quad . \quad . \quad . \quad . \quad . \quad (2).$$

$$\therefore \frac{\sin^3\theta}{\cos^3\theta} = \tan^3\theta = \frac{b}{a}. \quad . \quad . \quad . \quad . \quad . \quad . \quad (3).$$

$$\therefore \tan\theta = \sqrt[3]{\frac{b}{a}}.$$

To find the point A, we have

$$\frac{b}{pA} = \tan\theta = \sqrt[3]{\frac{b}{a}}.$$

$$\therefore\ pA = \frac{a^{\frac{1}{3}}}{b^{\frac{1}{3}}} \times b = a^{\frac{1}{3}}b^{\frac{2}{3}}.$$

Since $pA = x - a$, we have

$$x = a + a^{\frac{1}{3}}b^{\frac{2}{3}},$$

the result previously obtained.

It should be noticed that in simplifying (2) we multiply by $\frac{\sin^2\theta}{\cos\theta}$. This is permissible, since this quantity can be equal to neither 0 nor ∞ when the line AB has a minimum value.

From the above it will be seen that by a suitable choice of co-ordinates much analytical labour may be avoided. For this purpose no special rules can be given, but the student is advised to obtain the solution of a few problems, using different variables.

NOTES ON THEORETICAL MECHANICS.

BY F. CASTLE, M.I.M.E.,

Royal College of Science; Lecturer on Mechanics, Geometry, etc., Morley College, London.

ADVANCED AND HONOURS STAGES.

THE elementary methods by which the position of the centre of pressure may be found in simple cases are not of much use when applied to more difficult questions; and although various artifices may be used with advantage in a few special examples, it is much better, if possible, to use general formulæ. These may, if necessary, be applied to the simple examples already referred to, and, in addition, to more difficult questions in which the elementary methods are not applicable and cannot be used. Even the student not able to prove the formulæ may get confidence by using them to obtain numerical results. It will be advisable to first obtain the necessary formulæ, and afterwards show their application to a few numerical examples.

Total Pressure.—It is convenient to take two axes of reference—one axis, OY, in the surface of the liquid; the other, OX, at right angles to it.

Let A be the given plane area, x and y the co-ordinates of an element of area δa, and ϕ denote the inclination of the plane area to the vertical.

The whole pressure on the element of area is $\delta a x \cos\phi w$ (1), and the total pressure on the area A will be $w\Sigma\delta a x \cos\phi$, where w denotes the weight of unit volume of liquid.

From (1) the moments about the two axes will be $\delta a x \cos\phi w x$ and $\delta a x \cos\phi w y$.

As the moment of the resultant about a given axis is equal to the sum of the moments of all the elementary forces about the same axis, we have the relation—

$$\mathrm{R}\bar{x} = w\cos\phi\Sigma\delta a x^2 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

$$\text{and } \mathrm{R}\bar{y} = w\cos\phi\Sigma\delta a x y,$$

where $\bar{x}$ and $\bar{y}$ denote the co-ordinates of the centre of pressure, and R denotes the resultant pressure.

By definition, $\Sigma\delta a x^2$ is the moment of inertia of the area about the axis of Y. Denoting this by I, we have from (2)—

$$\mathrm{R}\bar{x} = w\cos\phi\mathrm{I}.$$

If $\bar{x}$ denote the co-ordinate of the centre of area, then from (1) total pressure $= w\Sigma\delta a x\cos\phi = w\mathrm{A}\bar{x}\cos\phi$.

Hence, as we have already found that in the case of a plane area the resultant and the total pressure are the same,

$$\bar{\bar{x}} = \frac{w\cos\phi\mathrm{I}}{w\mathrm{A}\bar{x}\cos\phi} = \frac{\mathrm{I}}{\bar{x}\mathrm{A}}. \quad . \quad . \quad . \quad . \quad . \quad (3).$$

$$\bar{\bar{y}} = \frac{\Sigma\delta a x y}{\bar{x}\mathrm{A}} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (4).$$

Equations (3) and (4) determine the co-ordinates of the centre of pressure, and its position is therefore known. In many cases, one line passing through the centre of pressure, and therefore one co-ordinate, is known; it is therefore only necessary to determine the numerical value of the other.

It will be seen that as (3) does not contain the angle ϕ, the position of the centre of pressure is independent of the inclination ϕ.

In dealing with the moment of inertia, we have already found (or it may be obtained from any text-book on the subject) that if I_0 denote the moment of inertia of a plane area about a line passing through its centre of area, then I, its moment of inertia about any line parallel to the former and at a distance $\bar{x}$ from it, is given by $\mathrm{I} = \mathrm{I}_0 + \mathrm{A}(\bar{x})^2$, where A denotes the given area.

Also, if K denotes the radius of gyration of the area, $\mathrm{I}_0 = \mathrm{AK}^2$. Using this relation, we have—

$$\bar{\bar{x}} = \frac{\mathrm{AK}^2 + \mathrm{A}(\bar{x})^2}{\mathrm{A}\bar{x}} = \frac{\mathrm{K}^2}{\bar{x}} + \bar{x},$$

$$\text{or } \bar{\bar{x}} - \bar{x} = \frac{\mathrm{K}^2}{\bar{x}} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (4).$$

From (4) we have the important result that the distance of the centre of pressure from the centre of area is $\frac{\mathrm{K}^2}{\mathrm{A}}$.

When the area is horizontal, $\bar{x} = \bar{\bar{x}}$, and this distance is zero; also when $\bar{x}$ is great compared with K^2, the quantity $\frac{\mathrm{K}^2}{\bar{x}}$ is very small, and may be neglected. The centres of area and pressure are then said to be coincident.

In the following examples applications of the formulæ are made to several important cases usually met with.

Ex. 1. As a simple example, it may be advisable to obtain the centre of pressure of a rectangular area, one edge in the surface.

Let b and d denote the breadth and depth (of the rectangle) respectively.

Moment of inertia of a rectangle about the edge b is $\frac{1}{3}bd^3$.

$$\text{Hence } \bar{\bar{x}} = \frac{\frac{1}{3}bd^3}{\frac{d}{2} \times bd} = \frac{2}{3}d.$$

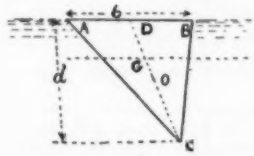
Ex. 2. Find where the centre of pressure on a rectangle would be if its plane were vertical, and its upper edge (which is horizontal) below the surface of the water, at a distance equal to the height of the rectangle.

Let b and d be the two sides of the rectangle, the side b being horizontal.

Here $\mathrm{I}_0 = \frac{1}{12}bd^3$; distance between axes, $\frac{2}{3}d$.

$$\therefore\ \mathrm{I} = \tfrac{1}{12}bd^3 + bd \times \tfrac{2}{3}d^2 = \tfrac{3}{4}bd^3,$$

$$\bar{\bar{x}} = \frac{\frac{3}{4}bd^3}{\frac{2}{3}d \times bd} = \tfrac{9}{8}d.$$



Hence the centre of pressure is at a point distant $\frac{9}{8}d$ from the upper edge of the rectangle.

Ex. 3. Find the centre of pressure in the case of a triangle, base b, height d, one side of which is on the surface of the water. (1881.)

Let ABC be the given triangle, one side AB in the surface; the centre of pressure is in the line joining the vertex C to the middle point D of the base AB.

The moment of inertia of triangle about a line passing through the centre of gravity G is $\frac{1}{36}bd^3$, and about the base (as the distance between the axes is $\frac{1}{3}d$) is $\frac{1}{36}bd^3 + \frac{1}{2}bd \times \left(\frac{d}{3}\right)^2$

$$= \tfrac{1}{36}bd^3 + \tfrac{1}{18}bd^3 = \tfrac{1}{12}bd^3$$

$$\bar{\bar{x}} = \frac{\mathrm{I}}{\bar{x}\mathrm{A}} = \frac{\frac{1}{12}bd^3}{\frac{d}{3} \times \frac{1}{2}bd} = \frac{d}{2}.$$

Hence the centre of pressure is at O, where $\mathrm{CO} = \mathrm{OD} = \frac{d}{2}$.

Ex. 4. Find the centre of pressure of a triangle, base b, altitude d, immersed in water, having its plane vertical, its base parallel to and its apex in the surface.

As before, $\mathrm{I}_0 = \frac{bd^3}{36}$ about a line parallel to the base and passing through the centre of area; hence the moment of inertia I about a line passing through the vertex, and parallel to the former, the distance between the axes being $\frac{2}{3}d$, is given by—

$$\mathrm{I} = \frac{bd^3}{36} + \frac{bd}{2}\left(\frac{2d}{3}\right)^2 = \frac{bd^3}{4}.$$

$$\therefore\ \bar{\bar{x}} = \frac{\mathrm{I}}{\bar{x}\mathrm{A}} = \frac{\frac{bd^3}{4}}{\frac{2d}{3} \times \frac{bd}{2}} = \tfrac{3}{4}d.$$

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MATHEMATICS.

STAGES 2 AND 3, SCIENCE AND ART DEPARTMENT.

BY G. A. BAXANDALL,

Assistant, Mathematical and Mechanical Division, Royal College of Science, London.

Text-Books.

Stage 2.—*Algebra.*—One of the following:—Hall and Knight's, with answers (Macmillan); C. Smith (Macmillan); Todhunter and Loney's (Macmillan); Hamblin Smith's (Longmans).

Trigonometry.—Hall and Knight's (Macmillan); Lock's (Macmillan); Loney's, Part I. (Cambridge University Press); Hamblin Smith's (Longmans).

Geometry.—Hall and Stevens's, Books I.–IV., or Books I.–VI. and XI.; Nixon's, Books I.–IV., or Books I.–VI. (Clarendon Press), or any other *Euclid*.

Stage 3.—*Algebra.*—Hall and Knight's *Higher Algebra* (Macmillan); Todhunter and Loney's (Macmillan); C. Smith's *Treatise on Algebra* (Macmillan); *Intermediate Algebra*, Briggs and Bryan (U.C.C. Press).

Trigonometry.—Hall and Knight's (Macmillan); Loney's, Part I. (Cambridge University Press).

Geometry.—Hall and Stevens's or Nixon's, as mentioned under Stage 2.

Stage 2.

Algebra.

Syllabus.—"Involution and evolution. Surds. Quadratic equations, and problems producing them. Ratio, proportion, and variation."

Involution.—Read chap. xv., Hall and Knight; chap. xxvii., Todhunter and Loney; chap. iii., Hamblin Smith; Arts. 66 to 69, and 164, C. Smith.

Attend mainly to the *rules* for squaring any expression, and for cubing a binomial expression. Apply these to work examples selected from the above chapters or articles.

Evolution.—Read chap. xvi., Hall and Knight; chap. xxviii., Todhunter and Loney; chaps. xvii. and xviii., Hamblin Smith; Arts. 168 to 170, 273 to 276, C. Smith.

Work examples on square root and cube root from those given in the above chapters and articles.

It is necessary that the student should work out many examples on the simplification of expressions, factors, problems involving the solution of simultaneous equations, etc. We append a few such examples here:—

1. Show that $a^2 + 3(a - 2b)^2 = 3(a - b)^2 + (a - 3b)^2$,

and that $\left(a + \frac{1}{a}\right)^2 - \left(b + \frac{1}{b}\right)^2 = \left(ab - \frac{1}{ab}\right)\left(\frac{a}{b} - \frac{b}{a}\right)$,

also that $\left(y - \frac{a^2 - xy}{y - x}\right)\left(x + \frac{a^2 - xy}{y - x}\right) + \left(\frac{a^2 - xy}{y - x}\right)^2 = a^2$.

2. Divide $x^4 - y^4$ by $x - y$, and from the result *write down* the quotient when $(x + y)^4 - 16z^4$ is divided by $x + y - 2z$.

Ans. $x^3 + x^2y + xy^2 + y^3$;

$(x + y)^3 + 2z(x + y)^2 + 4z^2(x + y) + 8z^3$.

3. A debtor is just able to pay his creditors five shillings in the pound; but if his assets had been five times as great, and his debts two-thirds of what they really were, he would have had a balance in his favour of £140. How much did he owe?

Ans. £240.

Trigonometry.

Syllabus.—"Definitions. Measurement of angles by degrees and radians. The trigonometrical functions, and the conversion of one into another. Use of the positive and negative signs to denote contrariety of direction. Tracing of the trigonometrical functions in magnitude and algebraic sign through the four quadrants. The arithmetical values of the trigonometrical functions of 30°, 45°, 60°, 75°, 90°, etc.

"*Logarithms.*—Definition. Multiplication, division, involution, and evolution by logarithms. The use of tables of logarithms of numbers, and of sines, cosines, etc., of angles. Tables of proportional parts for numbers and angles.

"*Triangles.*—Solution of all cases of right-angled and oblique triangles, and proofs of the requisite formulæ. Heights and distances. Area of a triangle."

Trigonometry.—We should like to mention at the outset that in addition to the text-books already mentioned, it is essential that students should possess a book of mathematical tables of some kind or other, including tables of common logarithms, sines, cosines, and tangents of angles. Extracts from these tables occur in text-books, and they are often given to seven decimal places. Chambers's Mathematical Tables are seven-figured, and would therefore do, but we would recommend Bottomley's four-figured tables (Macmillan).

It is *not* necessary that the student should read some of the articles which are usually to be found in the early portions of the text-books. Some of these are of the nature of proofs, and may be read to greater advantage at a later stage. It *is* necessary that he should at once become familiar with certain fundamental facts which we now refer to.

1. The length of the circumference of any circle contains the length of the diameter a little more than 3 times—say 3⅐ times, or, to be more correct, 3·1416 times. We do not know the exact number, but we denote it by the Greek letter π. Hence we have

$$\text{circumference} = \text{diameter} \times \pi = \text{radius} \times 2\pi.$$

2. In measuring the size of angles, either of two *units* may be used. The *first* is $\frac{1}{90}$ part of a right angle, and is called a **degree.** The *second* unit is arrived at in the following manner:—

Draw any two lines meeting at O. With O as centre, and with any length as radius, describe an arc cutting the two lines at A and B. If the arc AB be *half* as long as the radius, we say the angle is *one-half;* if *twice* as long, we say the angle is *two;* if the arc is equal to the radius, we say the angle is *one:* this is the *unit* angle, to which the name **radian** is given. The two angles just referred to would now be called half a radian and two radians respectively, so that we always have

$$\frac{\text{length of arc}}{\text{radius}} = \text{number of radians in the angle opposite the arc.}$$

How many degrees are there in a radian? Well, the arc of a semicircle contains the radius π times—that is, 3·1416 times; therefore there are π or 3·1416 radians in 180°. Hence

$$\textbf{one radian} = \frac{180^\circ}{\pi} = \frac{180^\circ}{3{\cdot}1416} = \textbf{57·29 degrees.}$$

Remember that π radians is the same angle as 180 degrees, and that when we speak of angle 2, or $\frac{1}{3}$, or c, or π, etc., it is understood that we mean 2, $\frac{1}{3}$, c, or π radians.

The number of radians in an angle is also called its *circular measure.* The estimation of angles in grades (French system) is only of theoretical interest.

3. Learn the definitions of the six trigonometrical ratios or functions—namely, sine, cosine, tangent, cosecant, secant, cotangent. Apply the definitions to work out examples like the following:—

(*a*) ABC is a triangle right-angled at C; AC is 4 and AB is 5, or, what amounts to just the same, sin B = $\frac{4}{5}$. Write down the numerical values of the six ratios for each of the angles A and B.

(*b*) If the angles A, B, C were 30°, 60°, and 90° respectively, it can be shown that the sides opposite these angles are in the ratio of 1, $\sqrt{3}$, 2. Attach these numbers to the sides, and write down the values of the six trigonometrical ratios for the angles 30° and 60°. You will have no difficulty in finding the answers in your text-book.

(*c*) If A and B are each 45°, the sides opposite are equal; and denoting each by 1, it easily follows that AB is denoted by $\sqrt{2}$. Attach these figures to the sides, and write down the values of the six trigonometrical ratios for A or B.

Work the following examples:—

Hall and Knight.—Ex. ii., iii. (*c*), iv. (*a*), vii. (*c*).

Loney's.—Ex. ii., iii., iv., vi. (Nos. 5 to 13), vii.

Lock's.—Ex. v., ix., x., xvii., xiii.

Hamblin Smith's.—Ex. iii., viii., ix., xvii., xiv.

It is intended that the student shall work a *few* from each of the sets mentioned.

Geometry.

Syllabus.—"The properties of rectangles, circles, and polygons, as far as they are treated in the second, third, and fourth books of *Euclid.*"

Read Propositions 1 to 7, Book II. *Work* Nos. 1, 3, 5, 7, 8, 9, 12 of the examples at the end of Book II. in Hall and Stevens, *or* the first half-dozen exercises on Book II. in Nixon's *Euclid.*

Stage 3.

Algebra.

Syllabus.—"Permutations and combinations. Progressions. Complete theory of indices. The binomial theorem."

There is much preliminary work to be done, including practice in such portions of the subject as solution of simultaneous equations involving quadratics, theory of quadratic equations, determination of maxima and minima values of expressions, etc. We shall first direct the reader's attention to these.

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LORD BISHOP OF CALCUTTA,

The Rev. J. E. C. WELLDON, D.D. (late Head-Master of Harrow School).

"Whatever may be the features of pernicious literature, there is, in my judgment, only one way of meeting it, and that is to meet bad literature by good. You may talk against bad literature, and I am afraid you will not have much effect; you may preach against it without much effect, for the great difficulty of preaching is that the people who hear sermons are not those who most need to hear them. But if wherever there is bad literature you spread good literature of such a kind that it is as interesting and attractive as the bad literature, then the battle is won, or, at least, it is half won. That is the work of this Society. If I may sum it up, it is to Christianise literature; it is to produce and to circulate literature which may, as the Secretary said, keep abreast of the times—which may, at all events, drive out in a large measure the literature of evil and of sin by its own innate superiority. No nobler, no more valuable service can be rendered to a community than this. If the evil literature, to which I have referred, deserves reprobation and condemnation anywhere, **it deserves it most of all among the young. I know something, by my profession, of the young, and I know there is a literature which in its nature is designed and intended to pervert the imagination of boys and even of girls.** To spread such literature is to poison the wells of society. That literature is one of the greatest curses of the age. It is most difficult to fight against. **It finds its way where it can hardly be expected or suspected,** and I can say of my own experience that sometimes its horrible effect is produced upon the minds of young people who, when they first begin to read it, have no idea of what they are reading. Because that literature is so pernicious, and because it is the object of this Society to counteract it, I, for one, as at present occupied in the teaching of the young, would render it my heartfelt thanks."

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Read the following articles or chapters, and work examples from the sets provided in the text-book :—

Hall and Knight's *Higher Algebra*.—Arts. 129 to 137, chap. ix.

Todhunter and Loney.—Chap. xxv., chap. xxxi., also Art. 525.

C. Smith's *Treatise on Algebra*.—Arts. 147 to 151, chap. ix.

Intermediate Algebra.—Arts. 110, 111, 112, 118, 119, 123, 124, 127, 129, 130, 135, 136, chaps. xii. and xiii.

Trigonometry.

Syllabus.—"Formulæ for finding the sine, cosine, etc., of the sum and difference of two angles, and of the multiples and sub-multiples of an angle. Diameters of circles inscribed in and circumscribed about a given triangle. Areas of regular polygons inscribed in and circumscribed about a given circle. Area of a circle. Description and use of the vernier and of the theodolite and sextant."

Read chaps. xi. and xii., Hall and Knight, or Arts. 88 to 108 in Loney.

These chapters and articles include a section of trigonometry which is of vast importance, and weeks of hard study are necessary before one can become sufficiently well acquainted with the various formulæ and the uses to which they may be put.

First there is the set of formulæ

$$\sin (A \pm B) = \sin A \cos B \pm \cos A \sin B,$$

and the corresponding ones for $\cos (A \pm B)$. For examination purposes the proofs of these must be known, A and B having any magnitudes. But the formulæ themselves must be thoroughly learned, because by means of them several other formulæ are deduced by the simplest of steps.

Then comes the set of formulæ which enable us to express the sum or difference of two sines or two cosines as the product of a sine and cosine, or of two sines or two cosines. These are extremely useful. If a student be *asked* to change from one form to the other, he can usually do it without much difficulty. But this is not enough. He must know them so well that if he sees the sum of two sines, for example, he must be *ready* (without being directed) to change to the product, or *vice versâ*.

Next come the formulæ for sin 2A and cos 2A, namely—

$$\sin 2A = 2 \sin A \cos A,$$
$$\cos 2A = \cos^2 A - \sin^2 A$$
$$= 2 \cos^2 A - 1 = 1 - 2 \sin^2 A.$$

But it is not the 2A and A that should be remembered. All these formulæ should be expressed in words. For example, the first one should be remembered as

sine of any angle = 2 sine of $\frac{1}{2}$ angle $\times$ cos $\frac{1}{2}$ angle.

Again, the formulæ for cos 2A should be known in many forms. For example—

$$1 + \cos 2A = 2 \cos^2 A,$$

or $$1 + \cos (\text{any angle}) = 2 \cos^2 (\text{half the angle});$$

also $$\cos^2 A = \frac{1 + \cos 2A}{2},$$

$$\sin^2 A = \frac{1 - \cos 2A}{2},$$

two most useful forms.

We have drawn attention to the formulæ, and indeed this is all we can do. It is difficult to sufficiently impress a beginner with their importance. It remains for him to work out dozens of examples, and these will be found in the text-books.

Geometry.

Syllabus.—"Ratio and proportion, with applications to geometry, as far as the subject is treated in the definitions of Euclid's Fifth Book and in his Sixth Book. The student should have accurate notions of the ratios of incommensurable as well as of commensurable magnitudes. He should be able to answer questions arising out of the subject. Correct demonstrations, whether those of Euclid or not, will be accepted."

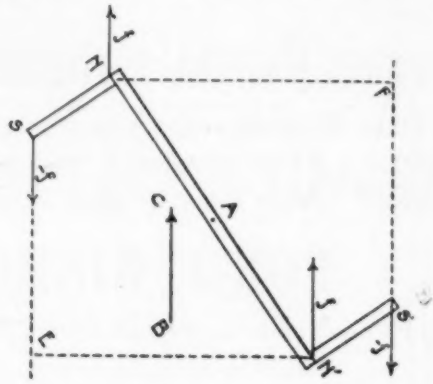
Consider carefully the definitions given in the introduction to Book V. in Hall and Stevens, or Nixon.

REPLIES TO SCIENCE QUERIES.

Alexandria.—The north-seeking poles of two equal and equally-magnetised magnets are attached to the ends of a light bar of wood, so that the magnets are parallel to each other and at right angles to the bar, and the south-seeking poles are on opposite sides of it. If the whole be suspended by a thread, so that the bar and the magnets lie in a horizontal plane, what position will the bar take with respect to the magnetic meridian? Give reasons for your answer.

(Science and Art, Advanced, 1888.)

Let NS, N′S′ represent the two equal and equally-magnetised magnets, of which the north-seeking poles, N, N′,



are attached to opposite ends of the wooden bar shown, the south-seeking poles, S, S′, being on opposite sides of it, and the directions, NS, N′S′, parallel. Then if this arrangement is suspended, by means of a thread, from the point A at the middle of the bar so that the bar and the magnets are horizontal, the whole arrangement will be unacted upon by the earth's field, and will, consequently, take up a position determined by the torsion of the thread, this position being independent of the direction of the magnetic meridian.

For suppose that the bar and its attached magnets are suspended in the earth's horizontal field, the direction of the latter being indicated by the arrow BC; then since the magnets are equally magnetised, the following forces will be exerted—the positive sign being affixed to forces parallel and similarly directed to BC, the negative sign distinguishing forces oppositely directed :—

At S, a force $-f$.
,, N, ,, $+f$.
,, N′, ,, $+f$.
,, S′, ,, $-f$.

Since for each force acting in the positive direction there is another equal force acting in the negative direction, there will be no tendency to move the whole arrangement bodily in any linear direction. We will next examine whether there is any tendency to rotate the whole arrangement.

The above-mentioned forces may be arranged so as to constitute two couples, as follows :—

1. f acting at N′, and $-f$ at S, at a perpendicular distance apart of N′E.

Numerical magnitude of this couple = $f \times$ distance N′E. It tends to rotate the arrangement in a sense opposite to that in which the hands of a clock revolve.

2. f acting at N, and $-f$ at S′, at a perpendicular distance apart of NF.

Numerical magnitude of this couple = $f \times$ distance NF. It tends to rotate the arrangement in the sense in which the hands of a clock revolve.

Since from the geometry of the problem distance NF = distance N′E, we see that the two couples are equal in magnitude, and tend to rotate the arrangement in opposite senses. Therefore the arrangement will be in equilibrium.

The above proof would apply equally well whatever direction were given to the earth's field BC, or, what comes to the same thing, whatever position the bar and magnets were placed in, in respect to the magnetic meridian. Therefore the position of the bar will be controlled only by the thread; or if that possesses no torsion, the arrangement of bar and magnets will remain in equilibrium in any position in which it may be placed.

(*See also page 268.*)

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OUR COMPETITION PAGE

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GRUSS ZUM SCHWEIZERISCHEN LEHRERTAG IN BERN,

8–10 Oktober 1899.

Von weissen Firnen zieht ein leuchtend Wallen
Hinaus, wo ferne, breite Niederungen
Herbstsonndurchwärmt im blauen Äther ruhn;
Und auch den Ruf, wie er so oft erklungen,
Wenn es im Lande Grosses gab zu tun,
Ich hör ihn wieder aus den Bergen schallen.

Euch mahnt der hehre Gruss, ihr Jugendleiter.
Hört ihr es nicht wie mächtig Flügelrauschen
Des jungen Adlers, der zum Lichte strebt?
Den Frieden gilt es heut an Kampf zu tauschen
Für Volk und Jugend. Ein Verhängnis schwebt.—
Frisch auf nach Bern, und jeder sei ein Streiter.

Bald wird man dort den hohen Bau vollenden;
Weit in das Land erglänzen stolze Zinnen,
Und eine Heldenschar blickt spähend aus,
Als fühlte sie ein dunkles Los beginnen
Und suchte nun des Krieges Not und Graus
Vom lieben Heimatboden abzuwenden.

Wir aber rufen "Bund," mit einem Male:
"Willst du ein Volk, das gross im Unglück handelt,
So nimm dich ernsthaft seiner Jugend an
Und sorge, dass sie lichte Pfade wandelt."—
Ihr Lehrer denn, geschlossen auf den Plan,
Hoch in der grauen Zeit die Ideale!—

RESULT OF THE OCTOBER COMPETITION.

French.

The prize is awarded to "C.E.M.," the pseudonym of Miss Montizambert, The Grove, Dunboyne, County Meath.

First Class.—Gecko, Polly, Canova, Luna, Consuelo, Kettering, Lynher, Carpe diem, Nortoniensis, Anastasia, Chemineau, Gutiger, Cæsar, Dies, Professeur, Lucille, Isobel, Automobile, Kingston, Dr. Dee, Pawney, Beginner, Reuben Butler, Diana of Poictiers, Sea, Homeless, Langton, Agaznog, Leonid, Rosine, Smoke, Nemo, Jimmuo, Fidelis, Tempus fugit, Rockwell, Map, Picciola, Sir Nigel.

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Third Class.—Beaulieu, Shamrock, Melita.

French Prize Translation.

I wish to assure myself personally of the existence of a sculptor signing with the same initials as you. I told you before that your Sosia, your sculptural double, was a friend of mine, and I feel sure that you will like each other when you meet this evening. He is a simple-hearted young fellow, who loves nature, and reproduces it truthfully. He is capable of creating heroic figures, such as the multitude passes by with indifference; but prefers to put his name to small-sized masterpieces, which he alone holds cheaply, but which attract and delight real connoisseurs, who recognise the true artistic feeling and original talent displayed in them. "I understand," said Maurice, bitterly: "your praise of Mario is indirect blame of me."—"You shall judge for yourself directly, for it is time for us to start for the salerooms, if we want to be there for the first fall of the auctioneer's ivory hammer." Aurelius took Maurice's arm, and together they betook themselves to the Rue Drouot. A great number of carriages were standing before the building. Well-dressed women, fashionable men, celebrated artists, were talking briskly as they ascended the wide staircase to the first floor, and proceeded to Room No. 2. The aspect of the purchasers thus assembled was not that of the customary dealers. The best-known bigwigs among the virtuosi had alone put in an appearance. The room was overcrowded, reserved places were taken by storm, and benches had to be climbed in order to get in, which the bird-painter and the unrecognised artist of the unknown Vercingetorix accomplished with some difficulty. "C.E.M."

German.

The prize is awarded to "Gutiger," the pseudonym of Vernon Howard, Silverdale, Fletton Avenue, Peterborough.

First Class.—Lynher, ——, Consuelo, C.E.M., White Heather, Polly, Celeriter, Cæsar, Spinne, Professeur, M.F.C., Dies, Student, Veilchen, Agaznog, Beginner, Caledonia, Integer, Baldur, Lebensfroh, G.C.M., Hendon, Viator, Norge.

Second Class.—Faust.

German Prize Translation.

Over the roofs of the capital rolled a murky November fog,

(Several Competitors were disqualified under Rules 1 and 2 this month.)

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whose veil sank deeper and deeper every minute, and so hastened the approach of night in an almost uncanny manner. The ruddy glare of the gas-lamps gleamed dim and fitful through the grey mist which enshrouded them; even the restless noise of the streets seemed to fall on the ear with a more muffled sound. The broad paving of the side walks had become bedewed with that dark, clammy moisture which is wont still further to heighten the inhospitable demeanour of a fog, and to double the longing for a cozy seat by the fireside. The stream of people, which surged backwards and forwards before the brilliantly-lighted windows of the splendid shops, found no time to-day to admire the display of costly wares. Every one seemed to hasten his steps to his utmost, and to have but one object in view—to reach his destination as soon as possible. In short, it was intensely uncomfortable in the street; and those who had no pressing business to execute remained closely barricaded in their own homes, and rejoiced in the comforting blaze of their oak log. "GUTIGER."

Report.

The French papers were by no means such a good selection this time as they usually are. Several phrases which should not have proved serious difficulties were in the majority of cases wrongly translated. Many competitors would do better if their reading of French were wider. For those who can spare the time, half an hour's reading each day would in time considerably increase a candidate's power of dealing with what are called "unseens." *Vous serez au mieux ensemble* was one of the phrases referred to, but *un blâme indirect à mon adresse* was a much more prolific cause of failure. Most candidates, finding out *adresse* in the dictionary, translated the whole as "a slur on my skill." *Faire de grands bonshommes* and *les gros bonnets de la curiosité* were also difficulties. The former means "to execute large-sized figures." There is somewhat of a sneer in it, which might be expressed by the use of such a word as "pretentious." *Curiosité*, in the second phrase, means "the world of dealers in curios."

The German was exceedingly well done, a large proportion of really excellent papers being sent in. Several competitors noticed the misprint of *von* for *vor*, but no one has been prejudiced who tried to make the best of the former word.

NOTES OF THE MONTH.

FROM THE PUBLISHERS.

MESSRS. CASSELL AND COMPANY have been exerting themselves for some time in the endeavour to encourage the teaching of patriotism and citizenship to the rising generation of British citizens. There is hardly a large elementary school in the country which does not use some of the patriotic reading-books issued by these publishers, among which are *The Citizen Reader*, by Mr. Arnold Forster, M.P.; and *Round the Empire*, by Mr. G. R. Parkin, to which that great Imperialist, Lord Rosebery, has contributed a preface. In view of the present state of affairs in South Africa, it is interesting to learn that two patriotic lantern lectures, entitled "A British Citizen," and "The Building of an Empire," issued by Messrs. Cassell and Company, are being delivered from time to time to English and native schools in our South African colonies. In our own country these lectures and slides are lent free of charge to teachers of evening schools, and have already been very widely used in many parts of England.

A NEW VOLUME BY SIR JOSHUA FITCH, under the title of *Educational Aims and Methods*, is announced by the Cambridge University Press. Its predecessor, *Lectures on Teaching*, delivered in the University of Cambridge under the auspices of the Teachers' Training Syndicate, has had a large circulation in Great Britain, America, and the Colonies, and has been translated into Spanish, and into one of the vernacular languages of India. That book dealt in succession with the principal subjects of ordinary school instruction, and sought to elucidate the principles on which all successful teaching depends. The forthcoming volume is more miscellaneous in character, and consists of lectures and addresses given in Cambridge, or before the Teachers' Guild and other bodies of teachers in England and in America. Its general aim is to direct attention to various aspects of educational theory and of practical work; and it includes several monographs on the lives of distinguished and representative teachers.

MESSRS. CLIVE AND CO. (U.C.C.) announce that the long-promised *Matriculation History of England*, by Mr. C. S. Fearenside, who is already known as the joint-author of the *Intermediate Text-Book of English History*, has now been completed, and is to be published during the coming autumn. The book is intended for use by candidates preparing for London University Matriculation, one of the requirements of that examination being "the history of England to the end of the seventeenth century." Particular attention has been given to the arrangement of the narrative, and to the avoidance of loose and inaccurate expressions which are found in many current text-books, and care has been taken not to confuse the learner with unimportant names and details. Introductory and summary chapters indicate the characteristics and tendencies of each period. Maps, plans, and tables have been freely introduced. The narrative of events before 1066 is unusually full, owing to the importance attached to this portion of our history at the Matriculation Examination.

MESSRS. WILLIAM BLACKWOOD AND SONS forward their autumn list, in which a special announcement is made of a new series of reading-books edited by one of our most esteemed contributors, Mr. John Adams, M.A., B.Sc., Rector of the Free Church Training College, Glasgow. The series, which consists of four volumes, seeks to do for literature what has already been done by many series of school readers for history, geography, and science. Many teachers feel that their pupils should be introduced as soon as possible to the works of the great writers, and that reading may be learned from these works at least as well as from compilations specially written for the young. Because of recent changes in inspection, the present is a specially suitable time for the introduction of such a series into elementary schools. In the preparatory departments of secondary schools the need for such a series is clamant.

It is to be noted that the books are not manuals of English literature, but merely Readers, the matter of which is drawn entirely from authors of recognised standing. All the usual aids given in Readers are supplied; but illustrations, as affording no help in dealing with literature, are excluded from the series.

GENERAL.

SPEAKING at the Prize Distribution which took place recently at the West Ham Technical Institute, Sir Henry Roscoe, F.R.S., said he was a member of the Commission which endeavoured to bring to the minds of the English people, and especially of Parliament, the knowledge of what was being done educationally on the Continent, with a view to ascertaining to what extent the schools which were established on the Continent and in the United States affected the industries of this country. The Commission came to the conclusion that the reason the industries on the Continent made such remarkable progress was due not to low wages and long hours, but to a higher and better knowledge of the scientific principles underlying the professions and the trades. While we in England had been improving our machinery, abroad they had been improving their men. *But during the last few years these technical schools had sprung up all over the country; and knowing what was done abroad, and having a pretty good knowledge of what was going on in this country, he ventured to say, both as regarded the extent of the education being given, and, what was equally and perhaps more important, as regarded the quality of that education, we should in a few years, if we progressed, as he had no doubt we should progress, be equal, if not superior, to our Continental friends.*

THE EDUCATION OF PUPIL TEACHERS.—In the course of a speech on educational topics, at Sheffield, on October 9, the Duke of Devonshire said that a Departmental Committee of educational experts in their recent report looked forward to the ultimate complete reformation of the pupil-teacher system; but he agreed with them that it was not desirable to sweep it away at once, or to make violent and revolutionary changes. We had scarcely got all the definite guidance that we were entitled to from the experts, but he thought one of our endeavours should be to give the pupil-teacher system a more elastic character, opening the way for the continuance of the old system as it still prevailed in many rural districts, but also welcoming the centre system which the Sheffield Board had adopted. This centre system had dangers of its own. There was a risk of such centres becoming mere cramming institutions, and of the pupil teacher attaching more importance to book learning than to the practice of his profession. The utmost care would be needed to guard against these risks by local authorities, as the Code alone could not possibly make full provision for the satisfactory working of the system without sacrificing elasticity in the regulations. Referring to educational expenditure, the Duke said he had hesitated to press upon the Treasury demands for further expenditure on education, that expenditure being already enormous, if not excessive. As for the religious difficulty, which was in some ways closely connected with the financial difficulty, he believed it was one which was not increasing in intensity.

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THE EDITOR'S TABLE

THE TEACHING OF GEOGRAPHY IN SWITZERLAND AND NORTH ITALY.

MANY English educationists, possessing little knowledge of the methods of teaching adopted at home, travel a few months abroad, and immediately constitute themselves authorities, ready to offer their advice on teaching processes to their less fortunate but, as a rule, much more enlightened brethren at home. In the reports of many of these seekers after second-hand knowledge, it is generally found that what is new and original is of little value, whereas that which is of real value is already well known. In marked contrast with these are the reports of others who have studied the educational system of their own country, who have passed through the process of actual and successful experience, and who are thus fitted to appreciate and estimate at their proper values the methods of teaching which in other countries, and under, it may be, very different conditions, have been found successful. The report on *The Teaching of Geography in Switzerland and North Italy*,* by Joan Berenice Reynolds, B.A., assistant mistress, Cardiff Intermediate Schools, and Gilchrist travelling student, 1898, belongs to the latter class. It is replete with valuable suggestions, and no teacher of geography can peruse its pages without being refreshed and immensely profited thereby. Those will profit most for whom it is primarily intended—namely, the teachers of Welsh schools. Miss Reynolds wisely selected the area of inquiry not only with the knowledge that Switzerland is the land in which the educational principles of Pestalozzi and of Froebel guide teaching methods, but with this further and perhaps more practical insight—namely, that the two countries, Switzerland and Wales, have much that is common in their geographical phenomena, and therefore much that might be common in the methods of teaching them. It follows that the work, whilst of value for teachers of geography in all localities, will prove of highest worth to teachers in the western and northern areas of Britain.

The report is prefaced by an appropriate and clear outline of the school grades in Switzerland. The following statement by Miss Reynolds, together with the accompanying diagram, will be perused with interest:—

> "Within recent years there has been some attempt at producing greater uniformity in the school syllabuses enforced in the various cantons; at present the differences are considerable. A primary teacher trained in one canton is not allowed to teach in certain other cantons without undergoing a fresh examination; this, added to the differences of language or religion, accounts, in a great measure, for the distinct schools of method which have been produced. As Professor Guex has pointed out, this system of educational 'Home Rule' has its inconveniences, sometimes narrowing the general horizon, and checking a wave of new inspiration at a cantonal frontier. On the one hand we cannot but agree with him in thinking 'that the scholastic system is more practical, more suited to the many and different needs of the three well-defined divisions of the country, than a centralised organisation. It has, moreover, the inestimable advantage of interesting every one in the schools, and causing educational progress to be considered not only as an honour, but also as one of the most important ends a community should strive to attain.'
>
> "I may here explain the spheres of the different schools and the names applied to them in French and German Switzerland respectively. Above the infant school, or kindergarten, comes the primary or elementary school, and attendance at this is compulsory at the age of six or seven. As a rule it contains six, seven, or eight classes, representing the ages six to twelve, thirteen, or fourteen respectively. The syllabuses for these schools are uniform for the canton, and elementary geography or 'Heimatkunde' (study of the home district) is generally introduced at the fourth school year, when the child is nine years old. From one to two hours a week is given to the subject in all the upper classes.
>
> "Above the primary school, but often overlapping its final years, is the secondary school, which in many respects reminds me of our higher-grade schools. It generally embraces two to four classes, or the years twelve or thirteen to fourteen or fifteen. The syllabuses are, as a rule, the same throughout the canton, and the majority devote two hours a week to the teaching of geography, which is taken by the class teacher.
>
> "Parallel with these secondary schools, most towns have a lower or preparatory section of a college, gymnasium, or canton school for boys, extending over the years ten, eleven, and from twelve to thirteen, fourteen, or fifteen, when much the same ground is covered in geography, and the same time given to it as in the secondary school. The boys who attend these schools are often drawn from a slightly higher social class than those who go to the secondary school with the probable necessity of leaving to earn a livelihood when fifteen years old. The masters also have higher qualifications, and teach special subjects, rather than all subjects to special classes; sometimes the school is richer in apparatus.
>
> "At the age of fourteen or fifteen the boy enters the college, gymnasium, or canton school, and is placed in that section which is supposed to prepare him for his future career.
>
> "These schools are divided into:—
>
> "(*a*) A Literary or Classical section, sometimes called a 'Lycée,' and leading on to the university.
>
> "(*b*) A 'Real' section, corresponding to the modern side of our grammar schools, and also leading to the university.
>
> "(*c*) A Technical and Industrial section.
>
> "(*d*) A Commercial section.
>
> "(*e*) A Pedagogic, Normal, or 'Seminar' section, for training the teachers for elementary schools."

It may be asked, "Why are the Swiss the most enlightened in geographical knowledge and teaching?" They are evidently very limited and localised so far as the area over which their geographical inquiries extend; they have very little interest in regions beyond the canton in which they live; they have no colonial empire; and yet we go to them for guidance, and not in vain. Miss Reynolds supplies the answer to our question. The Swiss make a thorough study of the area in which they live, and (fortunately for both the study and the scholar) that area, limited though it be, yields abundant and sufficiently-varied material. Besides the phenomena which nature has provided and placed almost at the door of every Swiss chalet and school, each canton provides text-books dealing with its own geographical, geological, botanical, and historical features. The various touring clubs have done much to stimulate and assist geographical inquiry, by the excellent charts, panoramic views, and magazines they have published. The report, we are especially glad to see, is sufficiently discriminating to note that the restricted but very thorough study of geography has its disadvantages; and that, excellent though its teaching results may be for the Swiss guides and mountaineers, it would not be well for us slavishly to copy these Swiss methods in their entirety. In this connection, the report says:—

> "'He who knows not his own country has no standard by which to know foreign lands,' writes Goethe. The Swiss child knows his country so well that sometimes there is very little time left for the knowing of other countries, and the instruction about them has to be so superficial, after the detailed treatment of his own land, that it is almost impossible to make him realise their relative size and importance. The sense of proportion has been lost, or rather never gained, and it is only in the advanced schools that it

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is gradually acquired. In the primary schools in cantons Appenzel, Freiburg, Schwyz, and Uri no attempt is made to teach more than the geography of the country; while in the primary schools of Bâle, Campagne, Bern, Glarus, Lucerne, St. Gallen, Soleure, and Unterwald all that is taught about other countries in Europe or the rest of the world has to be accomplished in two hours a week for one year, or less than this time. At Neuchâtel I found in the primary schools an attempt to convey some ideas on the geography of the world, side by side with the special work on Switzerland; but the teachers I spoke to complained that, owing to the time required for the constant repetition of Switzerland, this resulted in cramming, especially as girls, who came into the school from other cantons, were absolutely ignorant in this respect, and acted as a drag on the class."

Perhaps the most interesting as well as instructive portions of this report are those dealing with the "methods of teaching geography," and the chapters on the "school journey." The methods are termed "explicative," and not merely descriptive. A sample of this explicative method is reported, and a portion is here reproduced.

"As an example of this method, I will describe a lesson given in a girls' normal school at Neuchâtel, where, as the pupils were seventeen or eighteen years old, the strain on discipline, alluded to above, was not much felt. There were fifty girls in this class, each possessing a good map of Switzerland, which was kept open during the lesson. All of them had previously prepared the geography of the canton of Grisons. A detailed relief map of Switzerland hung on the wall. The professor called out a girl; she came forward to the map and indicated and named the chief valleys of the canton. She was then requested to read from the map the numbers indicating the height of the valleys at various points, and asked, from consideration of these numbers, to generalise as to the character of their slopes, and to express the generalisation as a diagram on the blackboard. The line was found to slope but slightly for the greater part of the way, but to have a sudden steep upward slant towards the end. The road along this typical valley was then added, at first as a straight line, and at last as a zigzag. Another girl was then called out, to trace in detail the valley of the Rhine through the canton; she was asked why the same valley went by different local names in different parts. Before the answer to this was given, she had to be asked to read again the numbers which showed the height at different points, and to represent the valley this time as a series of steps. Then it was seen that certain steps were of a nature to render traffic with the neighbouring steps or stages very difficult; in fact, that the valley really consisted of different basins, each of which was entitled to a distinct name. A third girl was questioned as to the climate in various valleys. Reading the map, she found that some, throughout their entire course, were higher than others, and concluded that the climate varied very much; then she named some of the productions capable of being grown in them."

Whilst the "explicative" method, as exemplified above, is used in the secondary schools, the "Heimatkunde" method is universally adopted in the lower classes of the primary schools.

"This name is elastic, and sometimes is used merely to denote that the geographical syllabus for the first year involves a certain amount of instruction about the schoolroom, the school building, and the playground, afterwards the streets near the school, and finally the town and district. The 'Heimatkunde' method, as conceived by the best teachers, however, involves far more than the introduction of certain topographical facts in this order, and refers rather to a system for training a child in scientific observation and power of description of any object, or collection of objects, which may be within his reach. The so-called object lessons, now well known in our own schools, more nearly correspond to a 'Heimatkunde' lesson than do many of the usual elementary geography lessons on school buildings and towns. A lesson on 'Heimatkunde' might often be called a lesson on elementary geology, botany, zoology, or history quite as much as on geography.

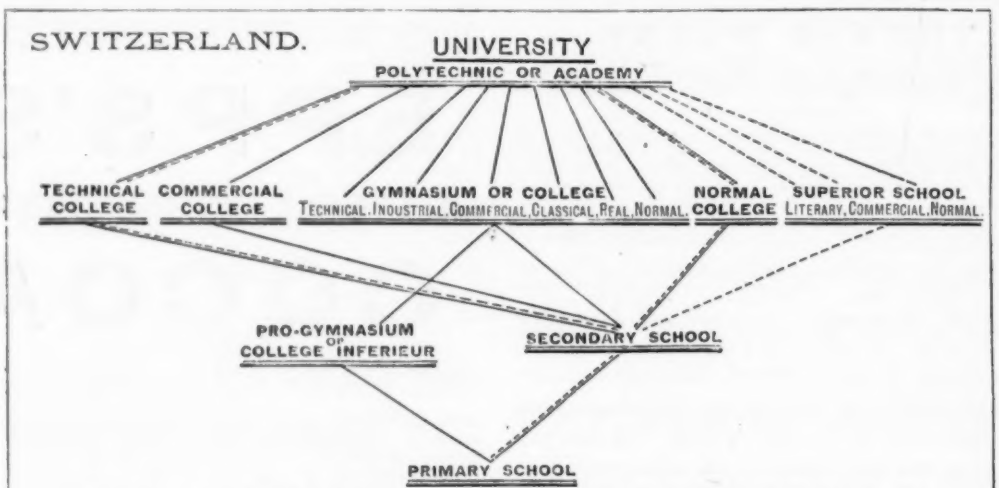

Diagram showing the Organised System of Public Instruction in Switzerland.

The continuous lines mark the course open for Boys: the dotted lines show the route for Girls.

In further illustration of these lessons on "Heimatkunde," Miss Reynolds supplies an illustrated specimen lesson in the following graphic account:—

"I will give as an example one in which the geographical aim was uppermost, and although it will involve rather a monotonous amount of repetition, I give it in order that the application of the method may be better understood. The lesson was given to a class of thirty boys and girls (ages seven to nine), forming the lowest division of the practising-school attached to the Normal School of Lausanne. As the subject of the lesson was the terrace of the castle, the first thing to be done was to take the class to the spot. They were told where they were going, and that they must notice the way there—whether the road was uphill or downhill, how long it took to arrive, etc. Then they were dismissed to get their hats and form a procession, four

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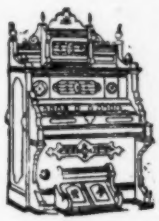

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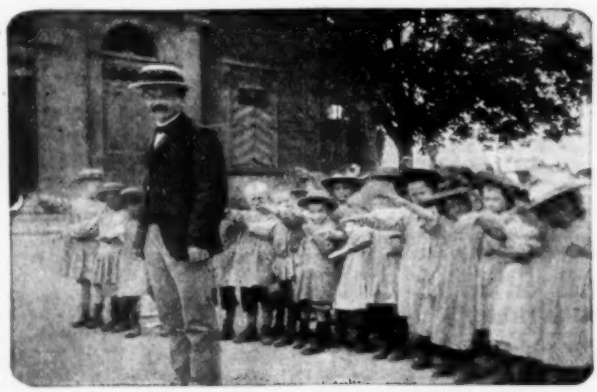
abreast. Well accustomed to these outdoor lessons, for one is undertaken at least every week, they were soon in marching order, and about three minutes later were drawn up in two lines on the terrace, in front of the steps they had just ascended. Two children were then appointed to count the steps by walking down them again, a ruler being given to another to measure the height of the step, while the rest looked on. The answers were recorded by the master in a notebook, and then he marched the children into the middle of the terrace, and told off two to count the number of paces necessary to walk its length, and two others for the breadth. These last two children, on returning, gave different answers; the rest were asked why. One pointed out a slight difference in the courses they had taken, but another noticed the difference in the size of the walkers, and the class realised that the tallest child covered the distance in a fewer number of paces than the other, as each pace was longer. The master took the mean of the two numbers given, and wrote it down. Their attention was next directed to an iron railing along one side of the terrace, and the reason for its existence; and a description of its appearance was given by the class, one boy being appointed to count the number of separate bars which composed it. They were questioned as to what also bounded the terrace on the north, south, and east sides respectively, having discovered that the terrace was on the west side. On the south side is a building called the Peristyle, which is the House of Parliament for the canton: a description of it was obtained from the class, who eagerly pointed out that the green and white painting on it proved it to be a building belonging to the canton.* The height of the wall on the north side was measured, and the castle briefly noticed: the steps form the east boundary. After this the children were asked to name what they saw on the terrace, and such replies were given as 'gravel, seats, trees, ourselves,' etc. The seats and trees were counted, the latter being contrasted and compared according to the character of their fallen leaves, while the master supplied the names. Finally they were drawn up in front of the railing to look at the view. The Jura mountains and lake were pointed out, and the children were asked what buildings in the town they recognised, and in what direction they were relative to the Cathedral. The whole lesson lasted perhaps half an hour, and then the children marched back to the school.



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"*Master.* What street are you in?

"*Child.* We are in the street Cité Derrière.

"*M.* In what quarter of the town is Cité Derrière?

"*C.* Cité Derrière is in the quarter of the town called La Cité.

"*M.* What is the chief building in La Cité?

"*C.* The Cathedral is the chief building in La Cité.

"*M.* Where is the Cathedral?

(And so on throughout the lesson matter.)

"Finally the children got out notebooks and copied the blackboard sketch, which was:—

THE TERRACE OF THE CASTLE.

Situation.
Size and shape.
What bounds the terrace.
What there is on the terrace.
What one sees from the terrace.
The visitors of the terrace."

* Green and white are the colours of Canton Vaud.

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